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FIELD MANUAL

EMPLOYMENT OF UNATTENDED GROUND SENSORS (U)

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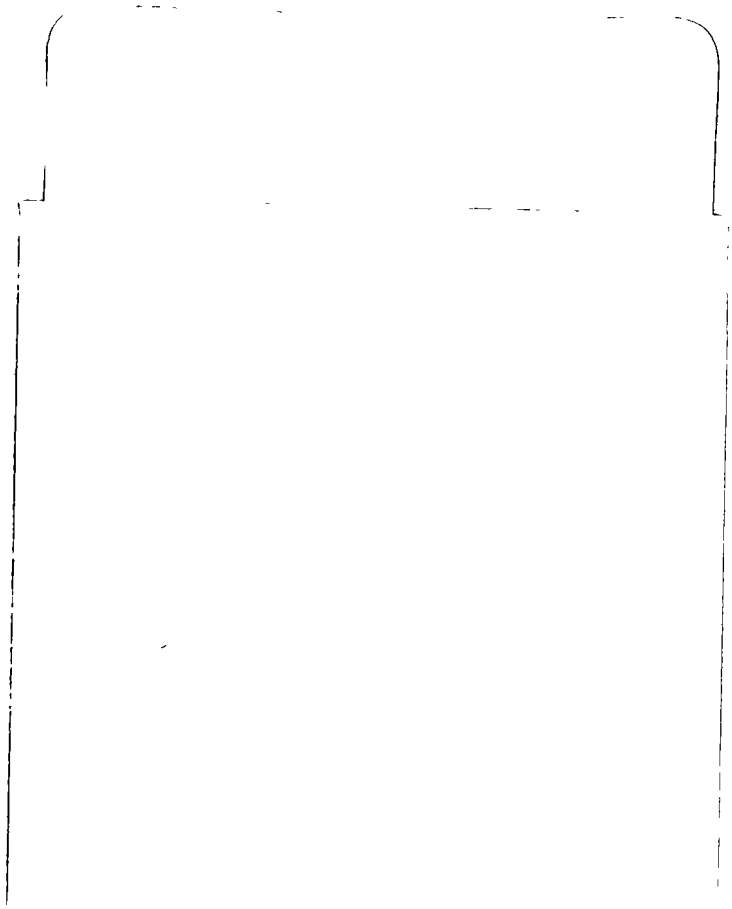

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FIELD MANUAL
No. 31-1 (TEST)

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *7 June 1971*

EMPLOYMENT OF UNATTENDED GROUND SENSORS (U)

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CHAPTER 1
GENERAL

1-1. (U) Purpose

The purpose of this manual is to provide employment techniques, command and control concepts, and a ready equipment reference for elements directly responsible for the emplacement and monitoring of unattended ground sensors (UGS's). See appendix A for references.

1-2. (U) Scope

a. The overall concept of employment for UGS's is for worldwide application; however, this manual will address only Phase III equipment in the SEA environment. The guidance published herein will require updating at such time as the sensor equipment is redesigned to fulfill worldwide requirements. Major considerations for such redesign are temperature extremes, precipitation, terrain variations, soil conditions, humidity, vegetation, indigenous population, and electronic environment. Included in this document is a summary of the characteristics, capabilities, and techniques of employment of individual material items in the SEA environment.

b. Several developmental items not currently in the Army inventory are addressed in the manual as they are expected to be in the hands of the user in the near future.

c. Users of this manual are encouraged to submit recommendations to improve the manual. Comments should be keyed to the specific page, paragraph, and line of text in which the change is recommended. Reasons will be provided for each comment to insure understanding and complete evaluation. Comments should be prepared using DA Form 2028 (Recommended Changes to Publications) and forwarded direct to the Commandant, United States Army Combat Surveillance and Electronic Warfare School, ATTN: ATSSV-OD, Fort Huachuca, Arizona 85613.

CHAPTER 2

CONCEPTS OF EMPLOYMENT

2-1. (U) General

Unattended ground sensors are employed to obtain information concerning enemy ground activity. Several types of sensing and monitoring devices are currently available, each designed to perform a specific function. The choice of sensor to be employed depends upon several considerations, such as the composition of soil, vegetation, terrain, sensor availability, emplacement accuracy desired, accessibility to site, and the tactical situation. The selection of monitoring equipment for each site depends primarily on the number of sensors to be monitored and radio line of sight between monitor station(s) and sensor fields. When they are properly used, UGS's constitute a significant resource as part of the total information-gathering capability. To assist in the overall combat surveillance mission, UGS's should be used to supplement and complement other information-gathering means. UGS perform a major role in the overall surveillance operation by filling gaps and voids which cannot be covered by other surveillance means. It is essential, therefore, that plans for the use of UGS's be integrated into the surveillance and target acquisition planning at all echelons.

2-2. (U) Sensor Roles

Sensors may be employed in three basic roles which are not bound by offensive or defensive considerations or by specific operational environments. The basic sensor roles are:

a. Alerting or warning.
b. Surveillance.
c. Target acquisition.

2-3. (U) Use of UGS's in Stability Operations

Enemy forces in an insurgency environment are normally offensively oriented. Therefore, friendly units must take measures to protect themselves from attack, even though their basic mission can only be accomplished by seeking out and destroying the enemy force. The nature, distribution, and attitude of the indigenous population will influence sensor employment. Friendly indigenous personnel can contribute significantly to the intelligence information required, whereas unfriendly, indigenous personnel may compromise sensor emplacement activities. Population density may preclude sensor deployment or complicate strike response to sensor activations. All of these considerations will influence the final plan for employment of UGS's in the SEA environment.

2-4. (U) Echelon(s) of Employment

The employment of UGS's in three basic roles does not restrict their use in any given echelon, however, the maneuver battalion is the lowest echelon with a capability to emplace a variety of sensors, to monitor multiple sensor output, and to react promptly to sensor-derived information. The requirement for timely information is greatest at this level. The maneuver battalion is also the lowest echelon at which the integration of sensor data and other information usually results in meaningful intelligence. The frequent employment of sensors in the target acquisition role by the maneuver element commander may prove highly desirable. During the planning sequence coordination with the appropriate fire support coordinator will assist in the effective use of available fire support. The key to effective employment of sensors is the immediate and simultaneous reporting of sensor-derived information to the supported unit and their fire support elements. Requests for fire support may be generated by UGS monitoring personnel through the supported unit; however, these requests are acted upon in the same manner as all other fire support requests.

a. The echelon which makes primary use of the information should emplace and monitor the sensors whenever practical. The employing echelon may at times require emplacement, relay or monitoring support; Army aviation may provide delivery and aerial relay support, if required.

b. Sensors delivered by other services are monitored by either the requester, the deliverer, or both. Dissemination of UGS information gathered by other services will normally be through intelligence channels.

2-5. (U) Mix of Sensor Types

A mix of sensor types assists in screening out nonhostile alarms and in refining intelligence data. The seismic sensor can be used to detect movement; the magnetic sensor can be connected to it to verify the presence of ferrous metallic objects. The acoustic device, when connected to the seismic device, will transmit the actual sounds that may be evident in the immediate area. Use of sensors, in pairs or emplacement of different types in close proximity, can assure a much higher reliability in the data derived from the field or string in addition to reducing signal responses from nonhostile activities.

2-6. (U) Methods of Emplacement

Unattended ground sensors may be delivered by air or artillery into areas which, because of terrain or the tactical situation, preclude hand emplacement. These various delivery means enable UGS's to be emplaced along difficult-to-reach routes and in enemy rear areas where excessive casualties may be sustained in maintaining manned surveillance systems. Emplacement techniques are required for each method of delivery. The Army concept of employment under a permissive air environment permits the emplacement of sensors from Army aircraft to the full extent of the aircraft range and endurance capability. This delivery capability may vary depending on the configuration of the operational area and the nature of the threat. The requirement for other service support for delivery of sensors will be less extensive than in a nonpermissive air environment because the Army can employ sensors with organic air capabilities. For emplacement techniques, see appendix B.

2-7. (U) Tactical Employment

a. General. The techniques for UGS employment are similar in offensive and defensive operations. For both types of operations friendly forces employ sensors in the alerting or warning role, the surveillance role, and/or the target acquisition role. Combat operations discussed in this section are representative only, and the principles apply to all similar operations. To integrate UGS's into the overall information collection system, each individual situation must be analyzed. The sensors should be used where the anticipated additional information they can produce is commensurate with the required expenditures of manpower and resources. The variety of types of sensors available offers flexibility in selecting sensors for special applications. UGS's are categorized according to detection means and method used to emplace the sensors in their operational locations. The detection means include seismic, acoustic, disturbance, electromagnetic, and magnetic.

b. Offensive operations.

(1) *General.* Sensors are used in offensive operations to locate the enemy and to assist in bringing him under attack. The sensors are emplaced in locations where the enemy is believed to be deployed tactically or in areas through which he is expected to move. Offensive operations visualize emplacement of strings of sensors, prior to the start of the operation, across or along the most likely enemy avenues of withdrawal. Plans are also made for the emplacement of secondary strings of sensors as the situation develops. Assistance in determining the enemy's location, direction, and rate of withdrawal can be gained by preplanned emplacement of sensors. The location of the enemy's surface-to-surface fire support positions may also be possible. It is usually desirable that the sensor emplacement, monitorship, and reaction strike functions be under the control of the ground force commander responsible for the overall operation.

(2) *Ambush.* An ambush offers a friendly unit the opportunity to inflict maximum damage on the enemy with minimum casualties to itself. Remotely fired munitions may be used with hand-emplaced sensors. Command detonated mines can be emplaced to cover the kill zone. The mines are detonated when the sensors indicate the presence of a suitable target. When the sensors are emplaced with sufficient accuracy, unobserved fire by artillery or mortars offers an ideal method of attacking confirmed targets. Plans for the use of unobserved field artillery fires and remotely controlled munitions require that friendly patrol plans and other scheduled movements in the area monitored by the sensors be thoroughly coordinated prior to being implemented. Care must be taken to prevent casualties to the civilian population. A variation of this application involves the use of sensors to alert an ambushing force of the approaching enemy. Sensor-derived information can also enable the ambush force to determine the optimum time to open fire.

(3) *Landing zone monitoring.* Under certain tactical conditions a commander may elect to preserve the element of surprise by making an air assault landing without firing a preassault preparation. Sensors are emplaced at probable enemy positions adjacent to potential landing zones and on probable routes to or from the landing zones. Information furnished by the sensors on the probable avenues of enemy withdrawal will assist in neutralizing an enemy force which could be occupying positions near the landing zone. They are monitored throughout the actual air assault operation. Information furnished by the sensors is used as a basis for deciding whether or not to execute the landing, fire a preparation, and select the specific landing zones.

(4) *Objective monitoring.* Offensive operations

may be oriented toward terrain or enemy personnel. When terrain objectives are designated, intelligence planning should include use of sensors. Emplacement of sensors on the terrain to be captured and along possible routes of approach to the objective area(s) provides the commander with increased intelligence upon which to base his decisions.

c. Defensive operations.

(1) *General.* Sensors are employed in defensive operations to obtain location, direction and rate of movement, and indications of enemy strength. Sensors are used along likely avenues of approach and in probable assembly areas to gain advanced warning of an enemy attack. They are also emplaced in known or suspected hostile mortar or rocket launching sites.

(2) *Base area defense.* Sensors are used in a base area defense to supplement other means of surveillance. A combination of various types of sensors can be installed around the perimeter of an area in an arrangement tailored to the terrain, vegetation, soil composition, and tactical situation. The use of sensors is coordinated with sentries and other detection systems and integrated with barriers and defensive fires into an overall defense plan. UGS's with a long operating life are most appropriate for employment in this application.

(3) *Extension of listening posts/observation posts (LP's/OP's).* Manpower limitations in a perimeter defense at night often preclude the establishment of LP's/OP's in the desired quantities or locations. Seismic sensors, paired with other types of sensors for confirmation of detections, can be hand emplaced as soon as it is dark enough to conceal activities. Also they may be emplaced by air to gain extended coverage and additional reaction time, or to reach otherwise inaccessible areas. Sensors are used to enhance security provided by contact patrols and flank security elements. In a defensive position, UGS's supplement contact patrols by covering gaps and augmenting flank security.

(4) *Convoy security.* Enemy intentions to ambush convoys can be detected through the use of sensors. Several days prior to the use of insecure routes by large convoys, seismic and acoustic sensors can be air-dropped into the areas best suited for enemy ambush. Upon receiving an indication of enemy activity, the convoy is alerted and the enemy ambush force attacked by fire and/or maneuver as appropriate. Plans for the use of UGS's in this manner are prepared and coordinated by the commander responsible for security of the convoy. Long-term surveillance of frequently used routes is provided by use of sensors which are activated and deactivated automatically or upon command.

d. Surveillance missions.

(1) *General.* Special surveillance missions generally have long-range objectives. Developing information concerning patterns of enemy activity or monitoring activity in a somewhat remote area are two examples. This type of mission can also produce intelligence which is of immediate tactical value.

(2) *Area surveillance.* One problem to overcome in counterguerrilla operations is to prevent the enemy from reoccupying a base area after it has been cleared by friendly forces. It may be neither possible nor desirable to destroy and make the base area completely unusable. It is usually impractical to leave troops in the base area to prevent enemy reentry. Frequently these areas are cleared only to be reoccupied by the enemy a short time later. Though sensors will not keep the enemy out of the base area, they can be used to monitor the area and to provide information on enemy reentry and the extent of their activity. Strings of sensors placed across or along access routes into the enemy base area are left behind and monitored by friendly forces to obtain information on enemy movements in and around the base area.

(3) *Route surveillance.* Sensors used to monitor infiltration routes can provide information to establish patterns of enemy activity. Use of appropriate sensor mixes enables traffic to be monitored over a variety of routes, such as roads, waterways, ridgelines, and natural defiles. Sensors can be employed throughout a network of enemy infiltration routes in border areas to monitor enemy movement and to develop information to plan offensive action. Sensors used to maintain surveillance of frequently traveled friendly routes, lines of communication, pipelines, and main supply routes can significantly increase a commander's capability to detect and prevent the use of mines and boobytraps by insurgents to interdict supply routes and restrict movement in and out of base areas. Sensor employment in this application reduces the commander's requirement for time consuming route-clearing operations prior to movement.

(4) *Physical security.* Sensors emplaced in rear areas, around logistical storage areas, prisoner facilities, command posts, and munition storage areas or radio relay sites can improve security and concurrently permit a reduction in forces performing security missions. As in other sensor applications, various combinations of devices afford the best means of detection and identification. Preparation of a complete security plan includes land mines, wire, sensors, field fortifications, fields of fire, fire support, and reaction forces.

(5) *Tunnel monitoring.* Application of sensors

can be made in tunnel monitoring missions. Although tunnels can be monitored at the entrance or from within, it is usually difficult to predict paths of movement by the enemy to and from the tunnel. When only a single sensor is employed because of the above restrictions, the number of personnel using a tunnel cannot be determined; however, the information that a tunnel is in use yields some information of value. It is possible that surface-monitoring of underground routes could be accomplished, depending on depth of the tunnel and knowledge of routes within the underground network.

CHAPTER 3

BATTLE AREA SURVEILLANCE SYSTEM (BASS) III

3-1. (C) System Description

a. BASS III is a second generation system for integrating selected equipment into a multichannel, wide area surveillance capability. It consists of modular equipment which is used in both local and wide area surveillance. It may be operated by various organizational arrangements as the situation dictates. The system with the use of communication relays extends the range and operational capability of local monitoring sites and provides for selective monitoring and control by higher headquarters over a wide area.

b. The BASS III is comprised of five subsystems (fig. 3-1): BASS relay central (BRC), sensor monitor, LORAN retransmission system (LORES), radio firing device (RFD), and command.

(1) BRC subsystem supports the other four subsystems. It intercedes between the sensors and the monitoring site equipment to strengthen sensor activation signals and overcome line of sight obstacles. It is also compatible with the long-range navigation (LORAN) system and serves as a relay between friendly ground and airborne elements and the LORES base station terminal.

(2) The sensor monitor subsystem consists of multichannel receiver and sensor display units which permit the reception of sensor activation signals either directly or through the BRC.

(3) The LORES subsystem is basically a radio repeater device which operates alongside the BRC equipment at a relay site. It has no BASS functions.

(4) The RFD subsystem enables personnel located at the monitoring site to engage targets located in or adjacent to a sensor field by remotely detonating prepositioned munitions.

(5) The command subsystem operates in conjunction with the sensor monitor subsystem. It is used to control commandable sensors which are discussed in the next chapter.

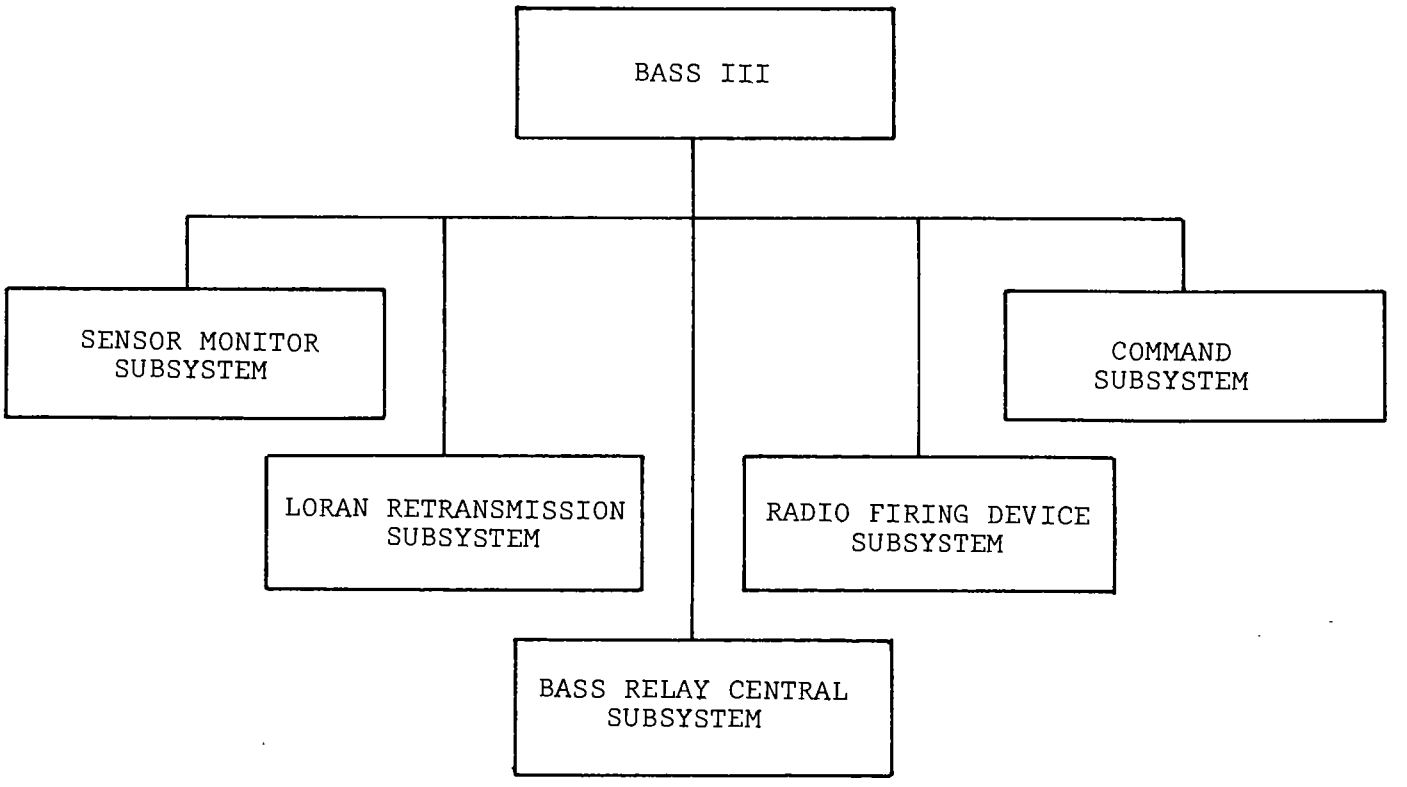

Figure 3-1 (U). Components of BASS III (U).

3-2. (C) BASS III Operational Considerations

a. Surveillance can be conducted in and targeting data obtained from areas that were previously considered inaccessible because of terrain, ground cover, weather, and enemy activity. The BASS system has the capability to monitor both direct (sensor to receiver) and indirect (sensor to relay to receiver) sensor activation signals. The information gathered by the sensors also fulfills purposes which differ at various levels of command.

(1) Larger areas are under surveillance at higher echelons and emphasis is placed on longer term pattern analysis and correlation with other intelligence to predict enemy location and movement. To facilitate this operation the monitoring site can be equipped with multichannel receiver units and associated sensor display units to provide a permanent record of sensor activations. Because of the amount of equipment which must be installed, its size and weight, and the time required to set up and check out the equipment, this type monitoring site is relatively immobile and infrequently displaced.

(2) At the lower echelons primary emphasis is placed on the immediate tactical situation where sensor-derived information is promptly integrated with other real time surveillance information. This information permits the tactical commander at company, battalion, or brigade levels to immediately apply appropriate combat power against fleeting hostile targets. The receipt of this information on a real time basis is also used for generating artillery fire missions or activating prepositioned munitions by remote control. To facilitate these operations the lower echelons use organic receiver and display equipment to establish monitor sites. This equipment, while remaining compatible with the BASS III subsystems, is small, lightweight, and man-transportable.

b. Overall planning for employment of the major components of BASS III will normally be at division level or higher because of the system's wide area coverage and requirements for extensive logistical support. Also, because of the distances involved and the requirement to monitor large numbers of sensors at these levels, the establishment of a relay becomes a primary planning consideration. This consideration is further complicated by the single retransmission capability of the BASS relay equipment. Without a multiple relay capability this limitation could be the determining factor for collocating a command post (CP) with the monitoring site. The only alternative involves establishment and operation of a dedicated communication system between the fixed monitoring site and the mobile tactical operations center (TOC).

(1) Normally the division G2 staff, supported by various intelligence organizations and guided by the established intelligence requirements of the command, will prepare plans for division-controlled and -monitored sensor fields in the division's tactical area of operational interest. In addition the G2, based on command guidance, will establish guidelines for the employment of sensors by subordinate elements. These guidelines will apply to the use of sensors in their long-range surveillance and target acquisition roles. The employment of sensors in short-term close-in alerting and warning roles will be under the control of the commander concerned.

(2) Whenever possible, sensors deployed by division order should be located to supplement those that have already been deployed by units in the area. Similarly, units moving into an area already under surveillance should plan to use existing sensor fields in their scheme of maneuver where possible. This mutual coordination is required to facilitate management of sensor personnel and equipment and to minimize the frequency management problem which is inherent in a wide area surveillance system, such as BASS III.

3-3. (C) BASS III Monitoring Site Equipment Description

a. BASS III equipment required at a monitoring site to support higher levels of command consists of one or more S-280 electrical equipment shelters with transporters, one or more 15-kilowatt generators, and an antenna complex.

(1) While the complexity and amount of equipment required is dependent on the number of channels and sensors to be monitored, the S-280 shelter can house one or more multichannel receiver units installed in field equipment racks and one to eight sensor display units. When commandable sensors are to be monitored, the S-280 shelter may also house equipment associated with the command subsystem.

(2) The necessity for the antenna array is based on the two reception modes: direct and relayed.

(*a*) Direct reception occurs in the mid-VHF band which necessitates VHF antennas.

(*b*) When terrain masking precludes direct reception and the BRC subsystem components are used, reception of relayed information occurs in the lower portion of the UHF band requiring different type antenna. This antenna is also used for transmissions when the command subsystem is employed.

b. Multichannel receiver units (MCRU) possess the capability to process sensor activation signals on eight channels simultaneously. The receiver components of this unit enable reception in three different modes; VHF signals directly from the sensors, UHF

from multichannel universal relay packages (MURP), and VHF/UHF from FM/FM relays.

(1) When direct reception of the sensor signals is possible, the receiver provides these signals to the MCRU logic unit and the operator's headset simultaneously. The signals furnished to the logic unit are converted to sensor identification code signals and provided to the sensor display equipment.

(2) When relayed UHF signals from the MURP are involved, these signals are first routed through a down converter component to convert them to VHF. Once converted, these VHF signals are routed to the receiver and processed in the same manner as described above.

(3) When the BRC employs FM/FM relay equipment, a different receiver component in the MCRU is required for reception. This FM/FM relay receiver component receives and routes incoming activation signals to the logic unit in the same manner as the VHF receiver described above.

c. The sensor display equipment consists primarily of one to eight event recorders. These recorder devices (XT plotters) each possess 60 pens which write on a moving sensitized paper roll when activated. By means of a patching panel, operator personnel can patch the input to each pen so it will record the activation signals for a specific sensor. For each activation the pens make a horizontal dashmark approximately one-eighth inch wide (twice the width of a typewritten dashmark). Appendix C contains detailed instructions for programing the pens and interpreting the recorded data. The sensor display unit is also equipped with two audio output connections for headset or tape recorder monitoring purposes.

d. The command subsystem, when installed with the other items in the S–280 shelter, performs two functions: command generator to prepare messages for specific commandable sensors and a command transmitter to transmit the messages, one at a time, either directly to the sensor or through a relay. The operating controls for this subsystem are located on the sensor display units. Detailed operating instructions are contained in appropriate technical publications.

3–4. (C) BASS III Relay Site Equipment Description

a. The BASS III equipment located at the relay site consists of an S–280 shelter and transporter, a 15-kilowatt generator, and an antenna complex similar to that at the monitoring site. The relay site is selected to facilitate line of sight between surrounding sensor fields and monitoring sites. The equipment performs the basic functions of:

(1) receiving sensor activation signals and retransmitting these signals to the monitoring site; and

(2) receiving command signals from the monitoring site and retransmitting those signals to commandable sensors.

b. The complexity and amount of equipment required to perform the relay function depends upon the number of channels the sensors will use, and whether or not the command subsystem will be employed. While the capabilities of the relay equipment may be expanded as required, the S–280 shelter will normally house an FM/FM relay package or a MURP. It may also house a command relay for use when the command subsystem is required and a LORES rack for use with the LORAN system.

(1) The FM/FM relay package provides a 16-channel relay capability. It consists of a standard FM receiver, FM transmitter, and data multiplexer which has been modified for installation in an S–280 shelter. Basically, the receiver provides reception for the sensor activation signals and retransmission to the monitoring site in the upper VHF and lower UHF bands. There are two identical FM/FM relay packages installed in the S–280 shelter. This duplication is provided to assure availability of a back-up system.

(2) The MURP is a component of the sensor analog relay system (SARS) which has been developed for use as a fixed-offset radio relay for Phase III sensor transmissions. The MURP provides a 2-channel relay capability. In applications requiring additional channels a total of four MURP's can be configured to provide an 8-channel capability. Each MURP contains amplifiers, receiver/transmitter units, and combiner units which enable it to receive VHF sensor signals, translate these signals to UHF frequencies, and retransmit them on one of three preset UHF bands. For a more detailed description of the SARS III, see the appropriate technical publication referenced in appendix A.

(3) When commandable sensors are emplaced within transmission distance of the relay site, the command relay equipment enables interrogation commands initiated at the monitoring site to be transmitted to a specific sensor through the relay site. To understand capabilities of the command subsystem, refer to figure 3–2 and note that any response by the sensor, once having been commanded, is transmitted through the BRC subsystem and received at the monitoring site by the sensor monitor subsystem.

(4) The LORES subsystem consists of relay equipment that performs a function in LORES similar to that performed by the command subsystem in BASS III.

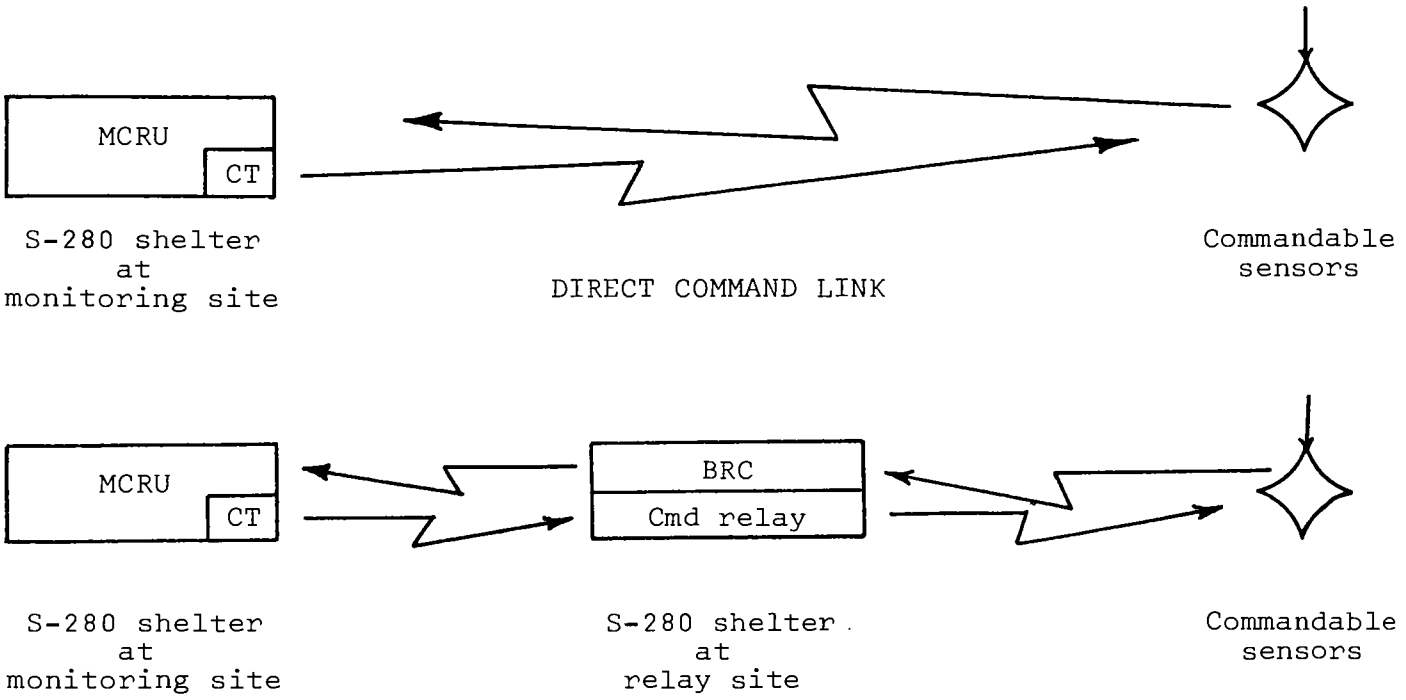

Figure 3-2 (U). BASS III command subsystem (U).

(*a*) The LORES is a communication system which uses retransmitted signals from the LORAN system to determine the location of friendly units in UTM coordinates and to provide navigational assistance to LORES-equipped aircraft.

(*b*) The LORES subsystem operates in the command link portion of LORES only. It relays command transmissions from the LORAN base station to the LORAN transponder. For additional information on both the LORAN system and LORES, refer to appropriate technical publications listed in appendix A.

3-5. (C) BASS III Equipment for Lower Echelons of Command

a. At company, battalion and brigade, BASS III equipment is smaller and more easily transportable than the equipment described for use at higher levels of command. The capabilities are generally less than those of equipment previously described.

b. To monitor sensor fields within the company, battalion, and brigade areas of interest, BASS III equipment described below is authorized in quantities which increase with each succeeding higher level of command.

(1) The Radio Frequency Monitor Set AN/USQ-46A (portatale) (fig. 3-3) is a militarized, portable VHF receiver used to receive, decode, and display the identification codes for any of 64 sensors on any one of 640 sensor transmission channels. Only one channel can be monitored at a time. The portatale is equipped with both a speaker and a headset and receives audio transmissions. It displays the sensor identification code for approximately 3 seconds on a 64-light visual display board. An output connector provides a means to attach the Signal Data Recorder RO-376/USQ for recording sensor activations automatically. The portatale can be powered by the familiar AN/PRC-25 radio battery or through a power supply group OP-63/USQ-46A which accepts the standard electrical current at 115VAC or vehicular electric current at 28VDC. The portatale is 4 inches high, 13 inches wide, and 10.25 inches long. It can be backpacked by foot mobile troops or installed in vehicles, aircraft, boats, or shelters. When configured with the AN/PRC-25 radio battery and encased in its canvas carrying case, the portatale weighs 17.5 pounds. When the portatale is to be mounted in a vehicle or a shelter, a variety of installation kits

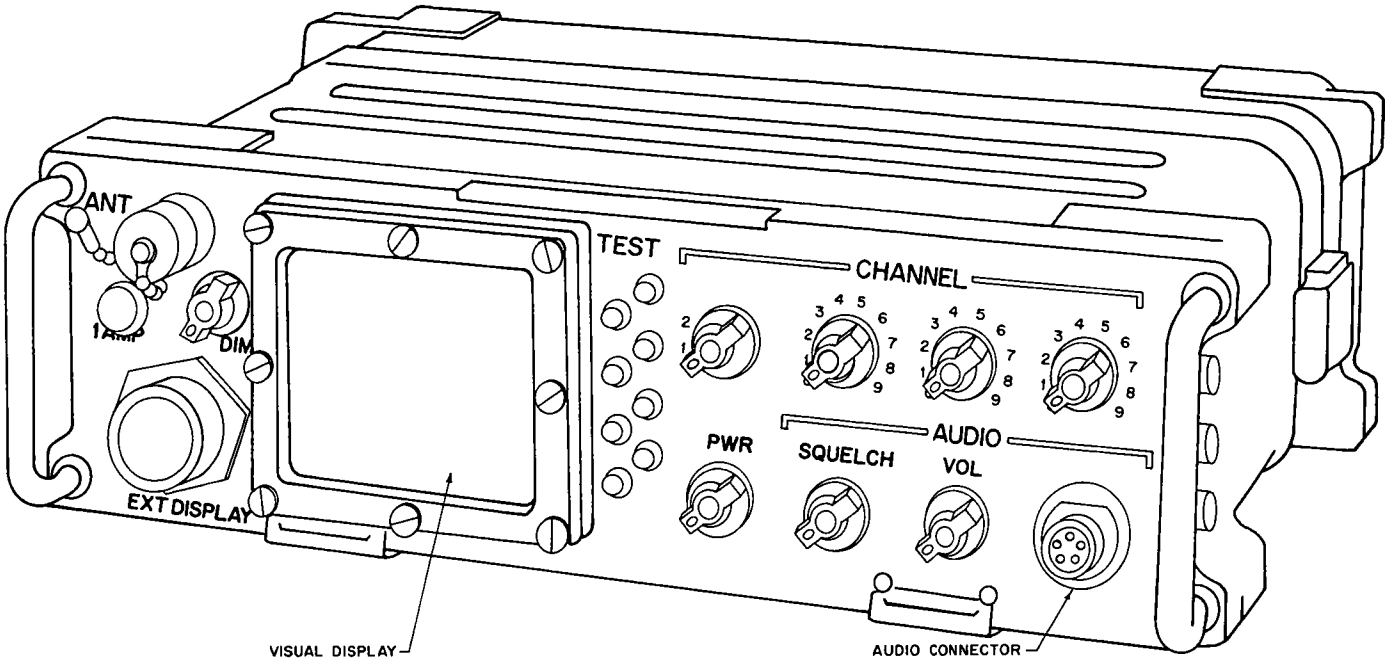

Figure 3-3 (U). Radio Frequency Monitor Set AN/USQ-46A (U).

are available. They consist of a mounting base, cables, antenna, and miscellaneous hardware attachments. However, the power supply group OP-63/USQ-46A which permits the portatale to operate from various power sources is not included as an item in the installation kit.

(2) The Signal Data Recorder RO-376/USQ (event recorder) is used in conjunction with the portatale (AN/USQ-46A) to record and display sensor activations (fig. 3-4). It uses a 30-pen chart recorder to make a mark in the appropriate column of a metallized charting paper by means of an electro-burning process each time a sensor activation signal is received. This charting paper moves at a constant rate of 12 inches an hour which permits the recorded sensor activation signals to be displayed as a function of time. (Appendix C discusses operator techniques used in the interpretation of such recorded data.) Although limited by the 30-column recording capacity, the event recorder accepts simultaneous input from two portatales. By means of a patch panel, the operator selects specific pens to record sensor activation data from specific sensors. The event recorder is 5 inches high, 14 inches wide, 18 inches long, and weighs 20 pounds. Its power requirement of 22VDC to 33VDC is supplied through the power supply group OP-63/USQ-46A. Hence, the use of the event recorder at a monitoring site is contingent upon the availability of an external 115VAC or 28VDC power source.

(3) The expendable relay (EXRAY) provides a single-channel relay capability which is readily available at the lower levels of command. It is used as an alternate to the BRC subsystem for relaying sensor activation signals from sensors which are not within transmission range or line of sight of the monitoring site. EXRAY's are available for both air-delivery and hand employment. Both configurations are self-contained, battery-powered relays which receive and transmit sensor activation signals on the same or a different VHF channel. Since the EXRAY is an inband digital-only relay device, it will not relay audio information from acoustic sensors and it cannot be used to relay command transmissions to commandable devices.

(4) The portable command transmitter (PCT) provides the lower levels of command with a sensor interrogation capability comparable with that provided at higher levels. It is a lightweight, self-contained, battery-powered portable device which may be used to transmit commands to commandable sensors either directly or through a command relay. When used to transmit commands directly to the sensor, it has an approximate transmission range of 1 kilometer. Like the command subsystem for higher levels, the PCT transmits only. To receive transmissions initiated by the commandable sensors in response to the PCT commands, a receiver device, such as the portatale, is necessary. See the illustrated command links in figure 3-5.

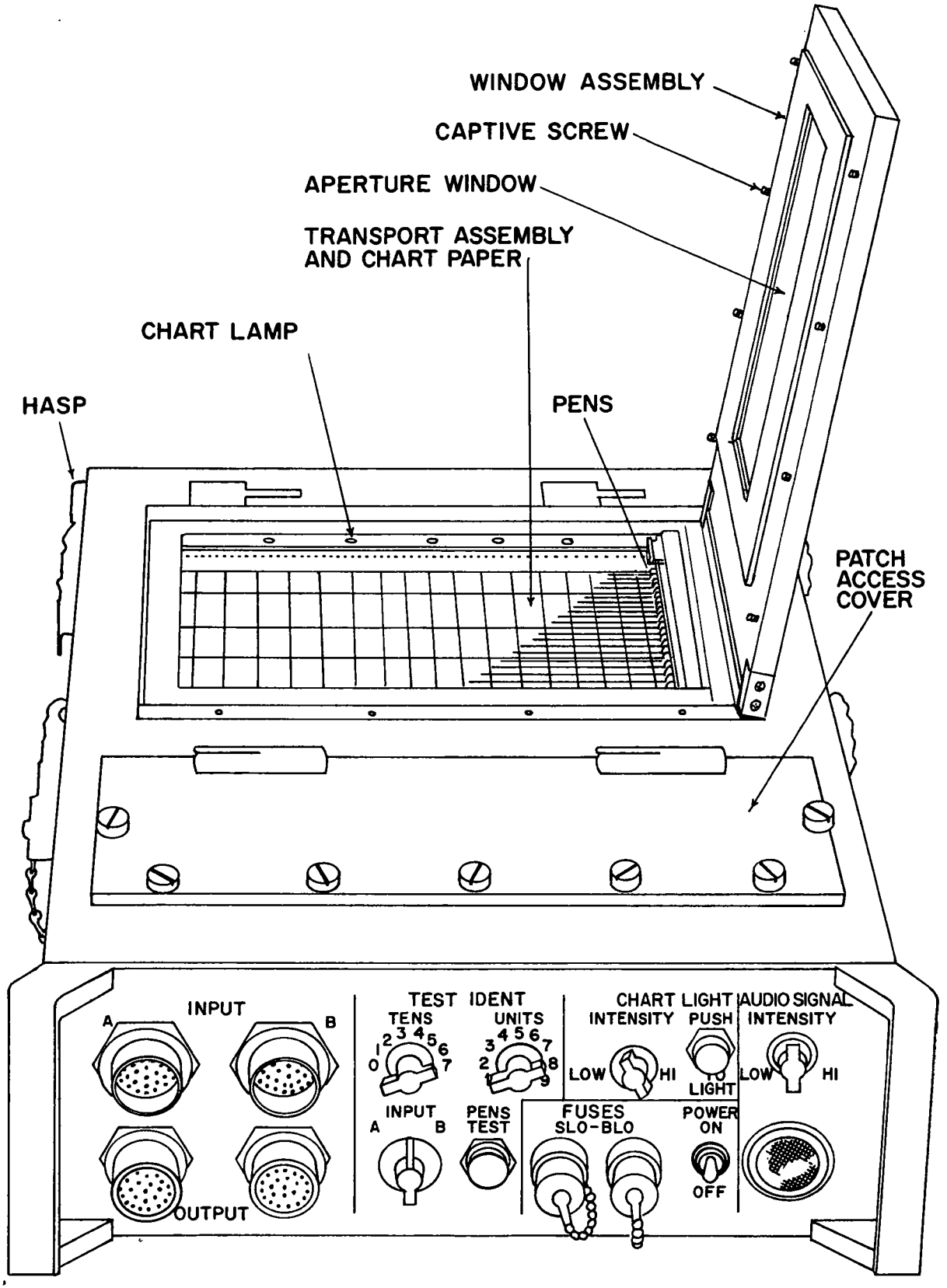

Figure 3-4 (U). Signal Data Recorder RO-376/USQ (U).

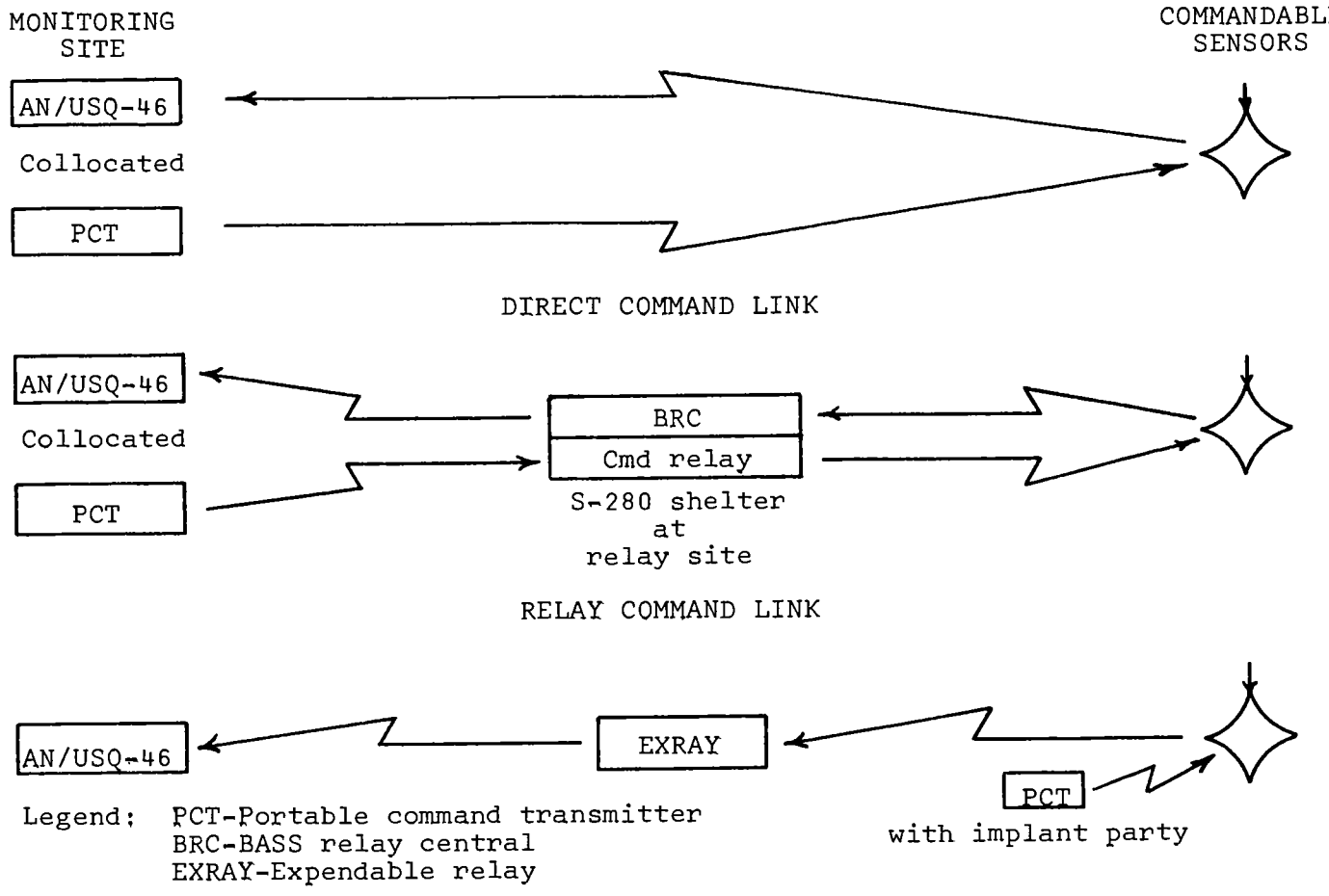

Figure 3-5 (U). BASS III command subsystem radio command links (U).

3-6. (C) The Remote Firing Device

The RFD subsystem consists of a control unit (CU) and a firing unit (FU) which employ dedicated communication links for both commands and responses. These two items may be used either independently or in conjunction with other BASS III equipment discussed above to provide an immediate attack by fire to sensor-derived intelligence. The CU controls the FU and has the capability to receive and display FU status information. Used in conjunction with sensors to detect and localize targets, the FU can be made to fire its munitions previously emplaced at selected locations for maximum effectiveness.

a. The RFD is envisioned for use in the basic roles of area denial, remote ambush, and local defense. FU firing outputs are delivered in any combination to six pairs of external terminals to each of which several blasting caps may be connected in series. Any munitions or explosives capable of being detonated by a blasting cap may be initiated by the FU. Normal artillery fire clearance and control procedures govern its employment. Both the CU and FU are of relatively rugged construction and are waterproof for normal operation. The CU may be operated safely in heavy rain. After connection of all munition strings the FU may be buried for concealment in soils ranging from hard and dry to very wet and muddy with no reduction in its capabilities or safety. The FU is equipped with a clock-like timer device to assure safe handling during emplacement. This timer, when operating, disconnects the electric power to the firing outputs.

b. The CU consists of a transmitter, receiver, a code card reader, and other associated circuitry. The CU provides the capability for selecting, encoding, and transmitting commands to the FU and for receiving, decoding, and displaying FU status responses. Each CU receives status on one Phase III sensor response channel and may operate with up to 64 FU's on that channel.

(1) To provide maximum control over the operation of the emplaced FU's and to eliminate the possibility of initiating a detonation from a spurious signal, each FU is supplied with a code card containing the address unique to that FU. This code card must be physically inserted into the CU for it to transmit commands to and receive responses

from that particular FU. No other command generator device can command the FU.

(2) When the CU is set up for operation and the appropriate code card inserted, the functional operation of the CU operator controls is as follows: activation of the STATUS COMMAND switch causes the FU being addressed to return its status which is displayed by the CU. Activation of the SAFE COMMAND switch transmits commands to cause the FU to assume the SAFE condition and transmit back its status; activation of the ARM COMMAND switch causes the FU to go to the ARM condition and transmit back its status. Activation of the FIRE COMMAND switch transmits commands to fire the selected string(s) (assuming that earlier the FU has been armed) and causes the FU to transmit back its status.

c. The FU incorporates a full set of Phase III sensor common modules plus a clock-like timing device. The FU receives, decodes, and executes commands from the CU, encodes and transmits its status and the status of the blasting cap strings back to the CU, and provides the capability for firing individually or in any combination of any six series-connected strings of blasting caps.

(1) The timer provides a minimum of 5 minutes after starting before connecting power to the FU. Before proper rundown of the timer, the FU is inert and safe. An "S" (for safe) on a green background is visible through the window when the timer is fully wound and ready to be started. When the timer has fully run down, an "A" (for arm) on a red background will appear in the window. The FU may be returned to a full SAFE condition, either during timer rundown or after, by moving the slide stop out and pushing in the knob. This disconnects the FU battery completely safing the FU, and the timer must be rewound to a full stop before starting again.

(2) Six pairs of firing output terminals located on the FU provide the capability to connect six separate strings of blasting caps. Terminal pairs are numbered corresponding to the STRING SELECT switches on the CU panel. Terminals are shorted together until a proper fire command is received and executed at which time the positive terminal is switched from system ground to the firing set output. Output of the firing set is sufficient to fire several blasting caps connected in series across the terminals with several hundred feet of firing wire. For example, eight blasting caps with 800 feet of 2-conductor wire such as standard WD-1 communications wire may be used. For actual operations refer to appropriate technical publications.

(3) All FU power is provided by one BA-1546 battery located in the detachable compartment of the FU. A minimum battery life of 30 days is anticipated. For extended life applications, another battery case containing an ACOUSID III battery may be attached to provide an estimated 140-day life.

CHAPTER 4
PHASE III SENSORS

4-1. (C) General

The major differences between Phase III and Phases I and II sensors are:

a. A limited increase in jamming protection.

b. An increase from 27 to 64 identifiers on each channel and a concurrent increase of available channels from 31 or 40 to 640.

c. The use of common module transmitters, encoders, and code plugs in most noncommand link sensors and the addition of common module receivers and decoders to specific sensors to make them command linked. Common modules in most sensors reduce logistic complexities and increase theater flexibility by allowing transmitter frequencies and sensor identifiers to be set at the sensor assembly facility. Phase III systems can be operated alongside earlier equipments; however, components (sensors, relay, monitors) are not always interchangeable between systems.

d. There are two classes of sensors, commandable and noncommandable. The commandable sensors use one each of all the common modules and the noncommandable sensors use only the transmitter, encoder, and code plug. Each common module is 2¾ inches in diameter and varies from 1 to 3 inches in length depending upon the type module. They are housed in an anodized-aluminum sleeve within the body of the sensor (fig. 4-1). All Phase III sensors, with few exceptions, incorporate a number of common modules in their design. Common modules include the transmitter, command receiver, command decoder, encoder, and code plug. The exact number depends on whether the sensor is commandable or noncommandable.

(1) The transmitter module in general is designed to operate on a selected frequency and to produce both a digital and analog modulation output. No tuning at the operator level is necessary. Stability in the assigned frequency usually precludes sensors from operating on adjacent frequencies without some mutual interference. Consequently, alternate channels must be left open and unused when UGS's are employed in the same general area.

(2) All sensors capable of operating with the command link use the common module receiver. Depending upon the sensor with which it is employed, the command receiver may use a separate UHF antenna or it may share an antenna with the sensor transmitter. In the latter case a diplexer is used to provide isolation between the command receiver input and transmitter output. Since the command receiver and transmitter of a given sensor are never required to operate simultaneously, the self-interference problem is minimized.

(3) The command decoder module is used primarily to decode command data from the com-

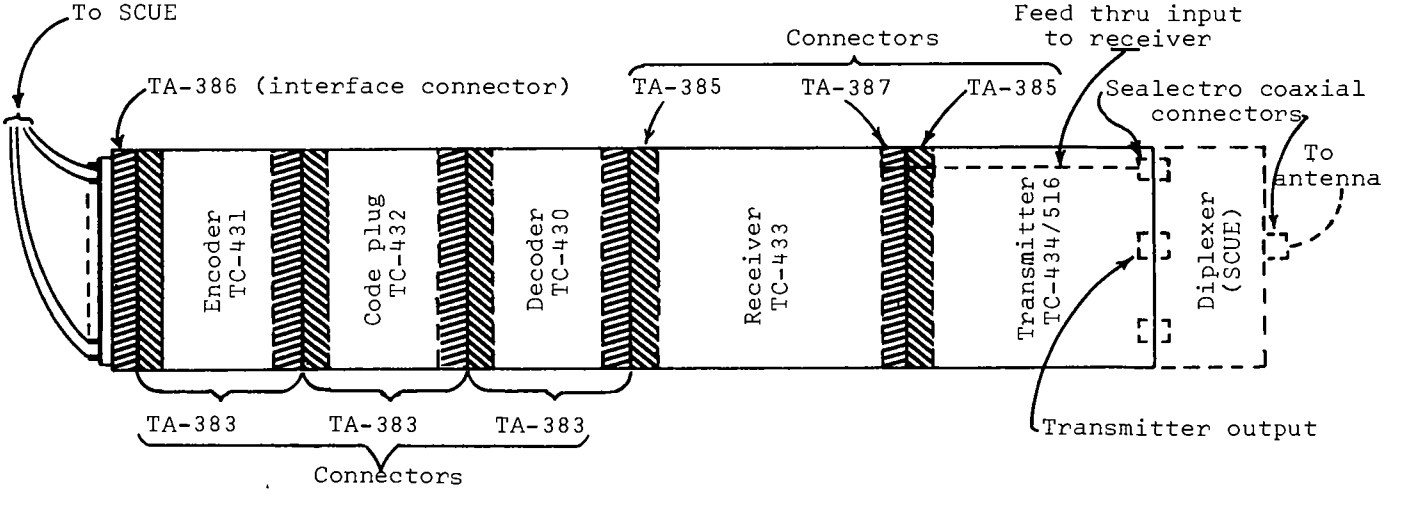

Figure 4-1 (U). Common modules (U).

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mand receiver module and provide the logic and control functions required by the command. Other functions included within the decoder are the event storage and the timing control for audio messages.

(4) The command encoder module is always used with the transmitter module. It provides control lines, message format, timing, and proper modulating signals to the transmitter for messages transmitted by the sensor. When a sensor is operating in the receive-transmit mode, the encoder may receive inputs from either the command decoder or the detector/processor.

(5) The common module code plug, with some exceptions, is used in all Phase III sensors. The sensor is programed by using the code plug which permits selection of various sensor parameters pertinent to the operation of the sensors. This is done when the sensors are assembled and a special tool is used for this programing operation. Once the code plug is programed, it is generally considered an irreversible process. However, limited corrections may be made on some of the parameters if assembly personnel are thoroughly familiar with the code plug and its functions.

e. The Acoustic Seismic Intrusion Detector (ACOUSID) III (fig. 4–2) is an air-deployed, expendable, camouflaged, Phase III seismic sensor with commandable acoustic readout for target verification/identification. It is intended to detect personnel and vehicles, and is deployed without parachute, implanting (except antenna) in the earth's soil on impact. There is an internal 28-volt, 13.6-amp hour, mercury cell battery which powers the sensor. Life for ACOUSID is contingent upon the mode of operation, number of seismic activations, and audio commands. Expected life is 90 days. On impact a switch initiates turn-on which closes after 1G-a-second change of velocity. After a 5- to 7-second delay all electrical circuits are activated. A geophone with associated circuitry detects the presence of moving personnel or vehicles by sensing earth motions generated by their movements.

f. The Air-delivered Seismic Intrusion Detector (ADSID) (fig. 4–3) is an air-deployed, expendable, camouflaged, noncommandable Phase III sensor. It is intended to detect moving personnel and vehicles and is deployed without a parachute, implanting (except antenna) in the earth's soil on impact. There are two versions of ADSID III: the short designated ADSID III/S and the normal, the ADSID III/N. Usually the ADSID III/N is emplaced by high-performance aircraft, and ADSID III/S is normally emplaced by dropping from a helicopter. The expected life is 110–120 days with a seismic activation rate of 15 activations an hour. On impact a switch initiates turn-on which closes after 1G-a-second change of velocity. After a 5- to 7-second delay all electrical circuits are activated. The sensor uses three of the common modules: the transmitter, encoder, and code plug. The transmitter module contains a small squib located near a critical component. The disable feature activates this squib, making the transmitter

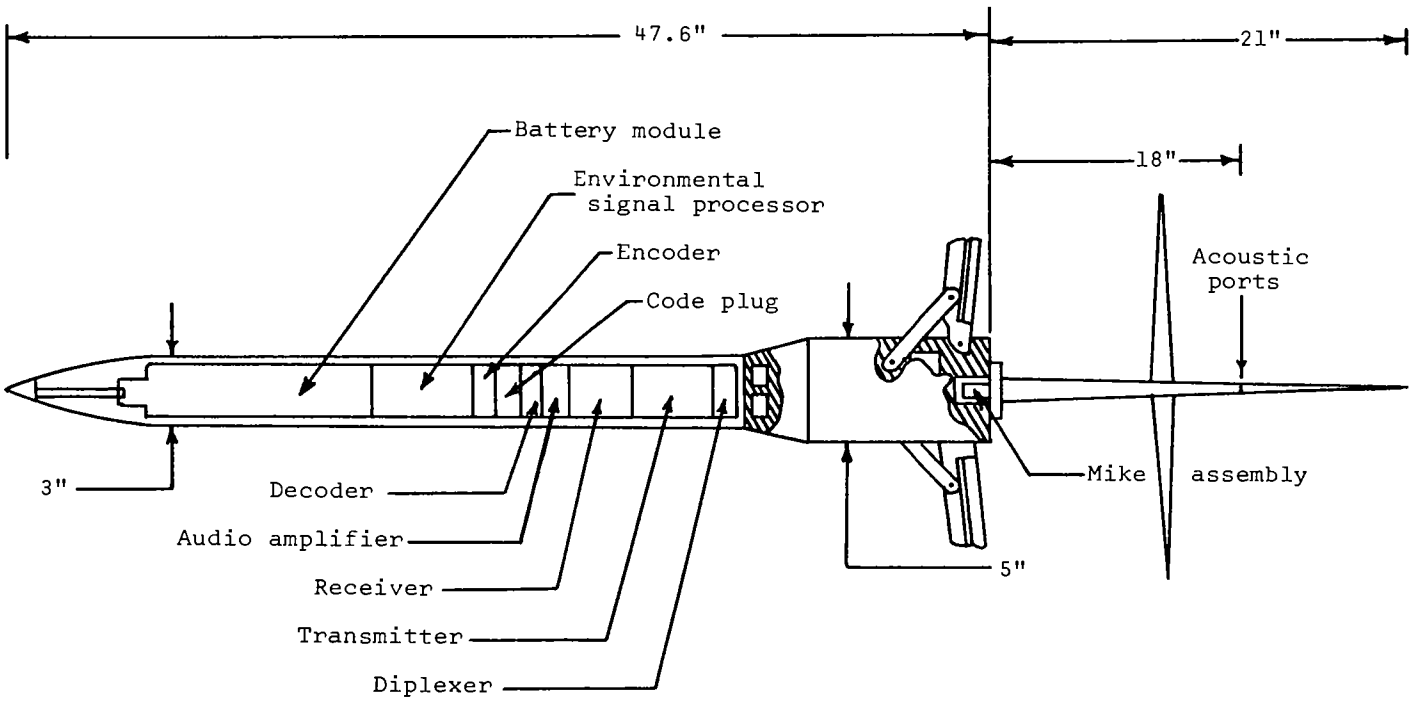


Figure 4–2 (U). ACOUSID III (U).

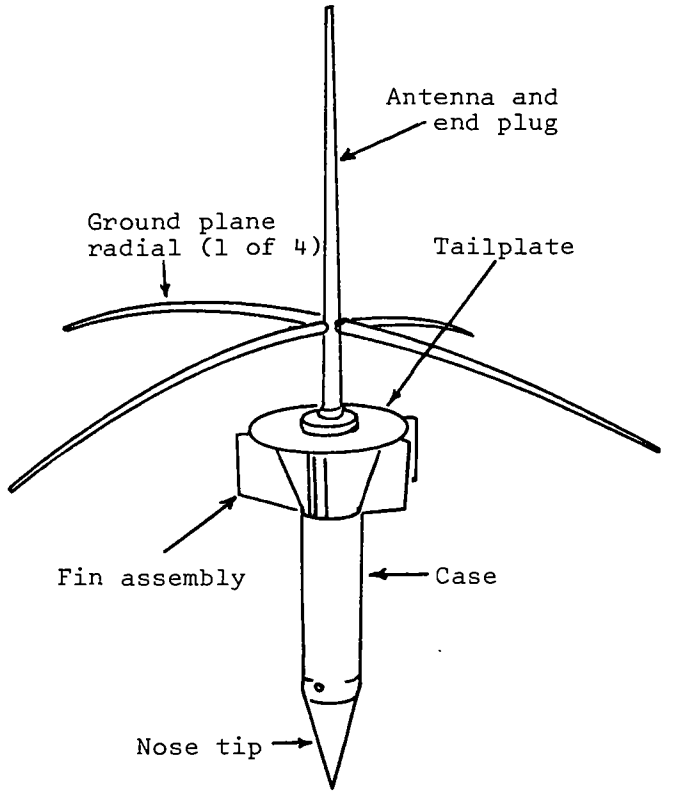


Figure 4-3 (U). ADSID III/S (U).

inoperative. The disable function is self-contained and not hazardous to personnel.

Note. The ACOUSID III and ADSID III/N are both equipped with a detachable afterbody (DAFT). The DAFT is used to allow for variations in the density of the soil. Should impact occur in relatively soft soil, the sensor body can penetrate below the surface while the aft plate and an antenna remain on the surface with a built-in trailing cable connecting the two.

g. The Noiseless Button Bomblet (NBB) and Automatic Radio Frequency Buoy (ARFBUOY) (fig. 4–4) form a system developed to provide a small, easily installed, all-weather, day/night system for intrusion detection capability. The NBB emits a unique radio frequency signal when physically disturbed, which is received by the ARFBUOY relay receiver. When this characteristic signal is received, the ARFBUOY III transmits its coded identification to a monitor station. The ARFBUOY III is designed for hand emplacement only. It can be hung in a tree (preferred) or placed on the ground. The NBB/ARFBUOY is designed to be field transportable and emplaced by one person. Sufficient power is available to provide 90-day life based on 1,200 activations a day.

h. The Electromagnetic Intrusion Detector (EMID III) (fig. 4–5) is used as a detector for

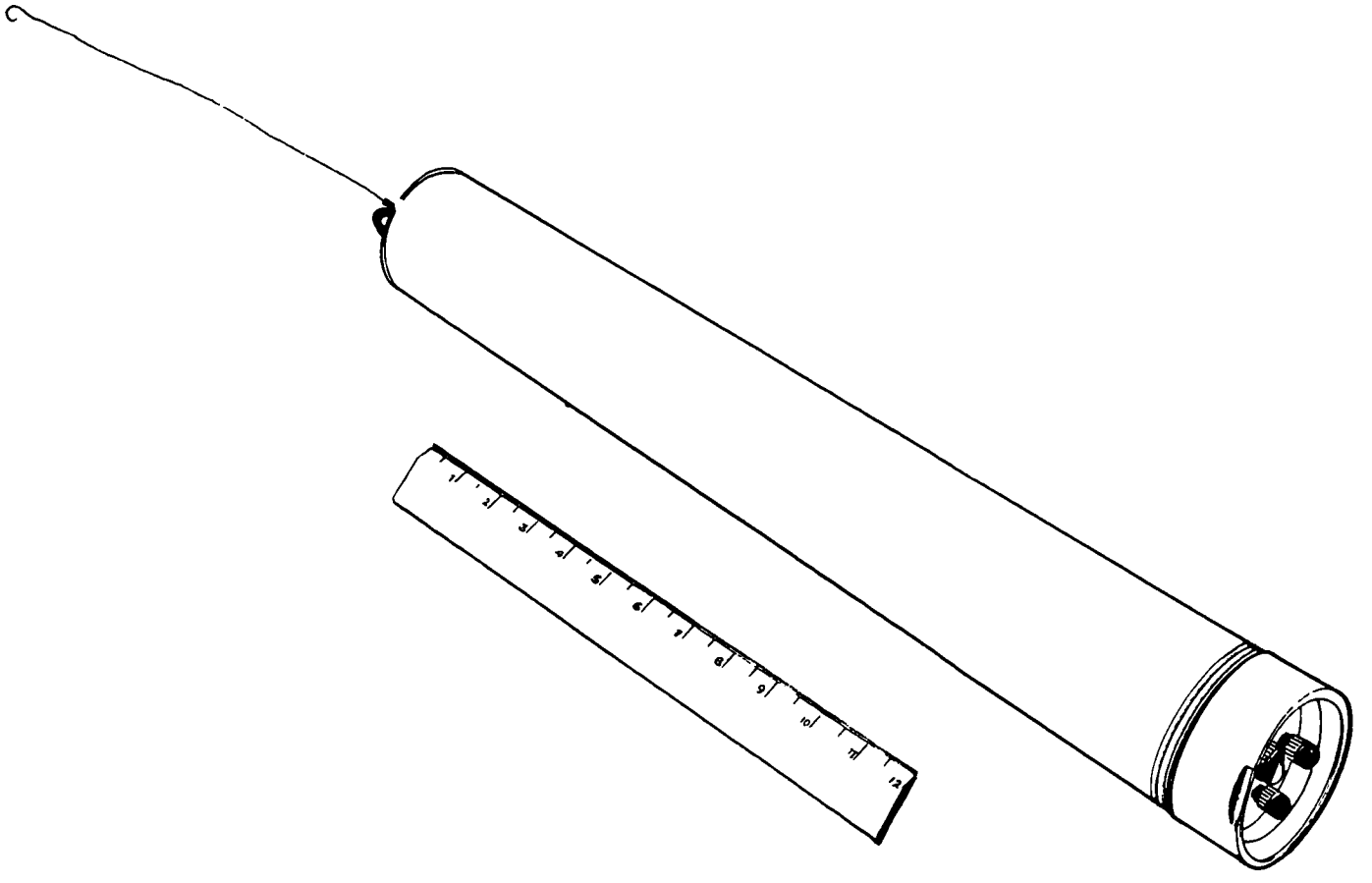


Figure 4-4 (U). ARFBUOY III (U).

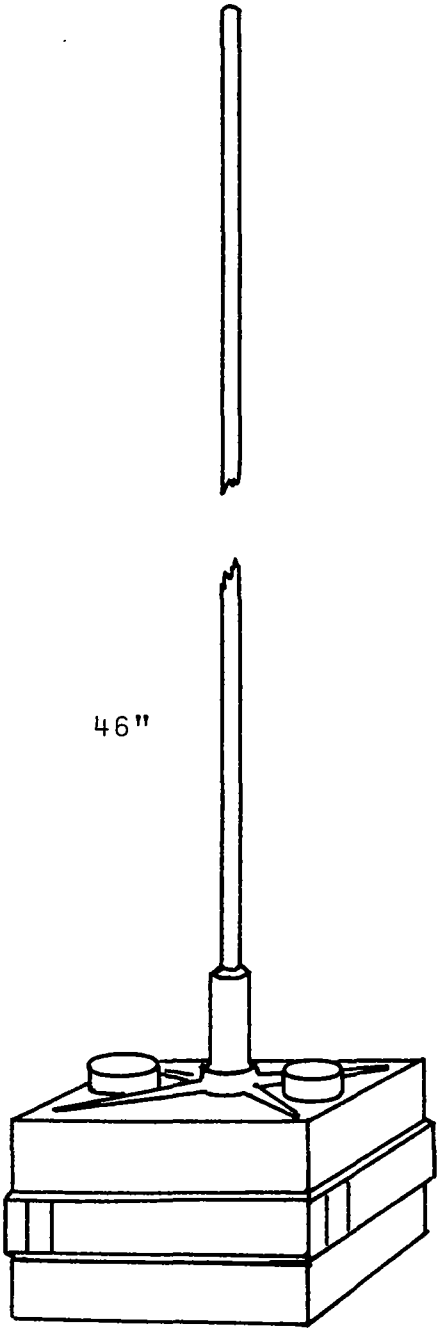
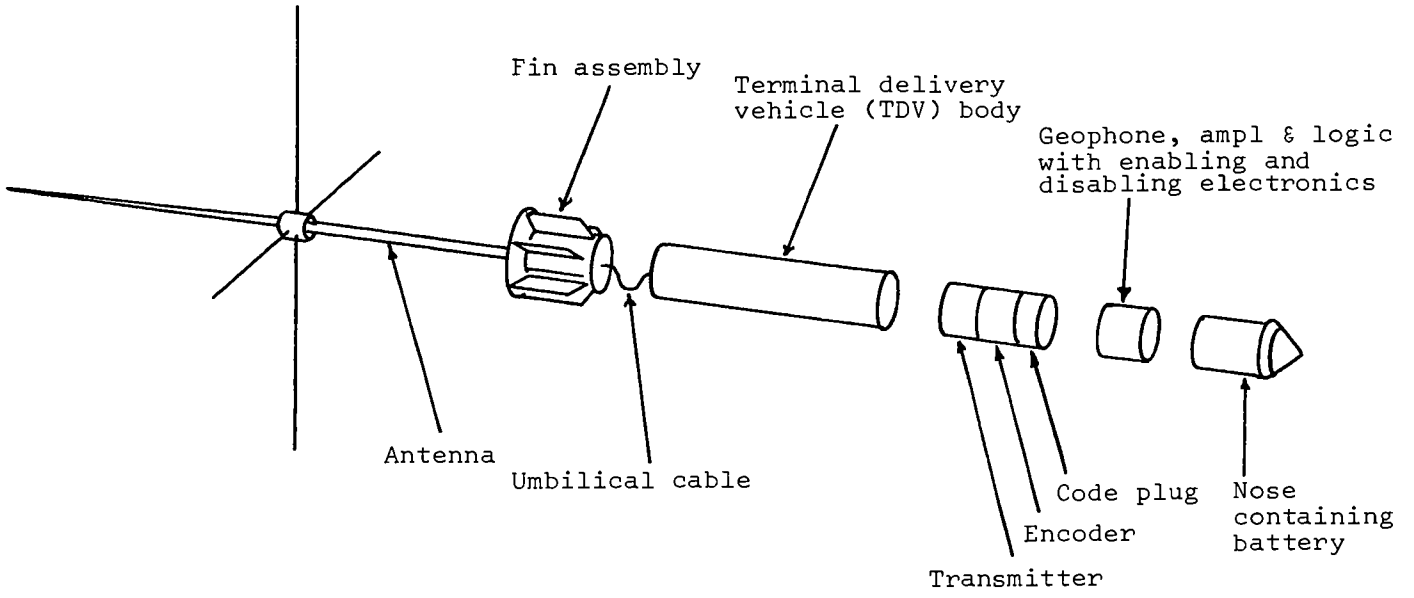


Figure 4-5 (U). EMID III (U).

moving watercraft and vehicles and a personnel detector. The detection mechanism is radar-like. A 60MHz cw signal is transmitted with an omnidirectional pattern, and signals reflected from moving targets are sensed at the antenna. Special circuits are included to minimize the response to the motion of nearby foliage. Life for EMID III is 45 days, based on 1,200 transmissions a day and continuous operation. An optional diurnal switch is provided to deactivate the sensor during daylight. This practically doubles the sensor life. The device has several advantages over other sensors. For example, unlike seismic detectors it does not respond to aircraft overflights, exploding ordnance, or rain. Unlike magnetic detectors, the target need not include iron or other metal. Unlike NBB's, physical contact with the sensor is not necessary. The present EMID III configuration is a self-contained sensor which includes a radio frequency detector, Phase III noncommandable reporting telemetry, and necessary disable circuits required by common Phase III sensor specifications. EMID III detects a sampan-sized nonmotorized watercraft passing within 25m of the sensor. The unit will also detect one individual who passes within 15m. Slow-moving vehicles are detected at slightly greater ranges.

i. The Medium Artillery Delivered Sensor (MARDS) III (fig. 4-6) is an expendable self-contained seismic sensor delivered from a 155-millimeter howitzer. It operates in real time only and is designed to detect personnel and vehicles at minimum distance of 30m and 300m, respectively. The device is transported in a standard M-449 base ejection shell. The sensor's electronics are housed in a specifically designed sensor case called "terminal delivery vehicle" (TDV). The TDV contains the geophone, associated electronics, antenna, and battery pack, all of which are necessary to sense seismic activity and to transmit identifying digital signals. Different propellant charges are used to achieve ranges out to 15,000m. A timer set before firing activates the ejection charge in the M-449 projectile and the TDV is ejected approximately 2,000 feet above the ground. Before impact, the TDV is slowed to a 200- to 300-feet-a-second terminal velocity. It impacts on line with and approximately 100m short of the distance traveled by the M-449 projectile. The aerodynamic design of the TDV insures flight stability and slows the spin rate to acceptable limits before impact. In soft soils the DAFT separates from the forebody and remains near the earth's surface. Sufficient coaxial cable connects the DAFT to the forebody to allow for various penetration depths. The antenna, located in the DAFT, self-erects to its transmission position automatically. The MARDS has an operating life from 7 to 15 days. It self-destructs upon tampering, improper implant angle, upon power loss, or preset timers.

j. MICROSID III (fig. 4-7) is a small, lightweight, self-contained, hand-emplaced sensor designed to detect seismic disturbances from the passage of personnel or vehicles. MICROSID III is especially designed as a microminiaturized device to provide a small, lightweight, easily portable, Phase III sensor for hand emplacement. It does not use common modules nor does it have a capability to receive Phase III commands. It contains an internal geophone, self-contained power supply, signal proc-



Exploded view of general design concept of seismic sensor

Figure 4-6 (C). MARDS III components (U).

essor, code plug, encoder, and transmitter. The sensor is buried up to the antenna, when deployed, to optimize the seismic coupling and maximize concealment. The detection range is 30m for multiple personnel and 150m for single vehicles. A mercury battery provides about a 30-day life operation with a transmitter activation rate of 1,200 a day.

k. The Miniature Seismic Intrusion Detector (MINISID) III (fig. 4–8) is a self-contained hand-emplaced sensor that detects the presence of seismic disturbances with an externally connected geophone and performs a signal signature analysis to isolate those disturbances that have specific characteristics. A radio frequency transmitter is activated when a disturbance is detected. This activation emits an identification code which identifies the specific MINISID III in addition to announcing the detection of a seismic signal. The MINISID III contains a nonexplosive, nonpyrotechnic, self-disable device that permanently disables the common module transmitter when an attempt is made to tamper with the sensor without first deactivating the disable circuitry. Battery life is approximately 60 days and the detection range is 30m for multiple personnel and 300m for vehicles. The MINISID III is also designed to operate with different types of external detectors.

(1) The Audio Add-on Unit (AAU) (fig. 4–9) is used with the MINISID III as an external sensor to provide an optional acoustic transmission capability and/or longer life. The AAU includes a microphone, an audio amplifier and a 28-volt power supply. The microphone is attached with a 10-foot cable to permit remote location. When the microphone cable is plugged in, the AAU provides an acoustic signal to the MINISID III for 15 seconds upon receipt of three successive seismic activations from that sensor. The AAU functions as an external battery for the MINISID III if the microphone cable is not connected. The AAU is capable of operation while buried. It consists of three assemblies: the electronic package, microphone and cable assembly, and battery assembly. Detection capability and range of the AAU are equal to or better than ACOUSID III. It is equipped with an optional diurnal (light sensing) switch that when activated automatically deactivates the sensor during daylight hours.

(2) The Magnetic Intrusion Detector, T–4 (MAGID) (fig. 4–10) is used with the MINISID III to detect changes in the ambient magnetic field when passing ferro-magnetic material, such as a rifle or a vehicle. The MAGID is designed to operate as an external detector for the MINISID III. It may be operated in the "BOTH" mode where near-simultaneous seismic and magnetic detections are required to activate the MINISID III transmitter. Also the MINISID III transmitter will activate alone as a magnetic detector in the "MAGNETIC ONLY" mode. The combined MINISID/MAGID operating life is approximately 60 days. The MAGID T–4 weighs 7 pounds and its detection range is 3m to 4m for one man with a rifle and 15m to 20m for tracked vehicles and large trucks.

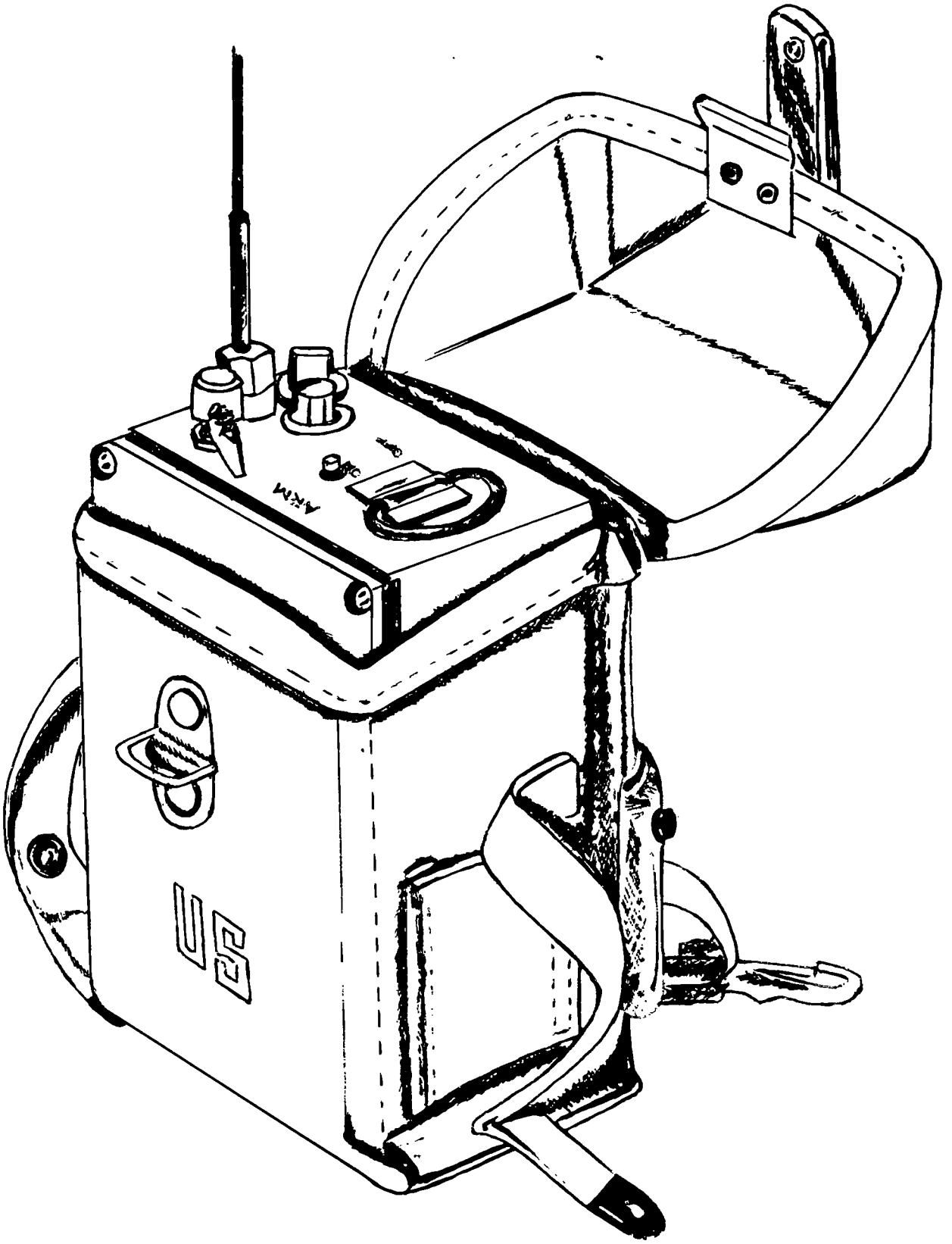


Figure 4-7 (U). MICROSID III external view (U).

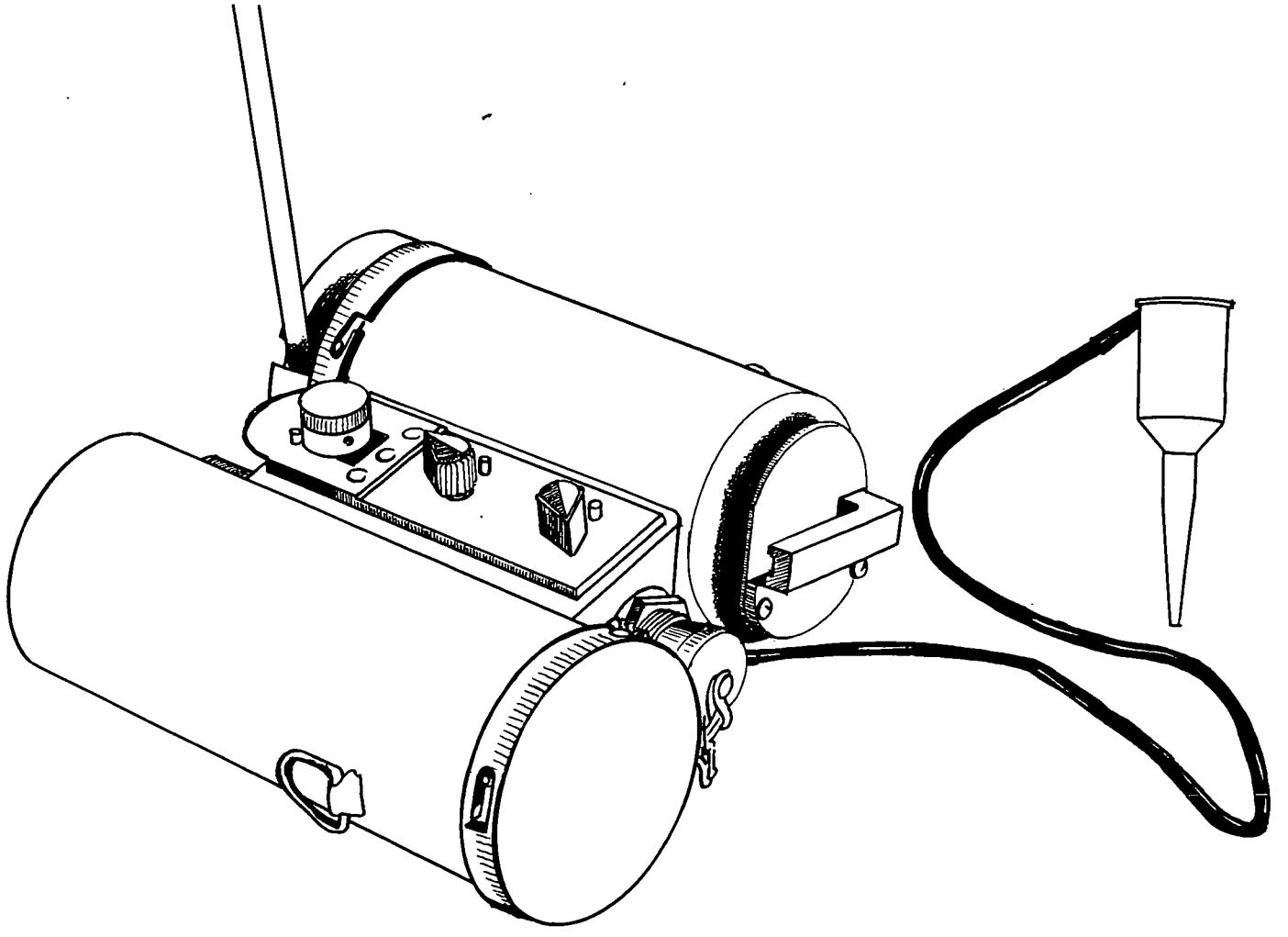


Figure 4-8 (U). MINISID III (U).

(3) The family of external detectors for the MINISID III will eventually include sensors employing both electromagnetic and underwater sonar detection techniques.

l. Disposable Seismic Intrusion Detector (DSID) III (fig. 4-11) is a small, lightweight, hand-emplaced, self-contained seismic sensor. It is nonrecoverable and nonrepairable. The DSID III has one external switch for OFF, TEST, and ARM positions. Prior to issue, sensor assembly personnel accomplish internal adjustments for the sensor's sensitivity and identification code. The programed operating life can be reduced from 65 days to 7 days, if desired. The DSID's operating channel is selected from one of 84 fixed channels. Its transmitter has a minimum power output of 2 watts. After the external switch is moved to ARM position, a disable will occur:

(1) if the switch is moved from ARM position;
(2) upon low-battery voltage;
(3) at end of selected life; or
(4) if the case is opened.

The DSID weighs 4.5 pounds and its detection range is 30m for personnel and 300m for vehicles.

4-2. (U) Summary

A summary of the types of sensors, their characteristics, and emplacement techniques are shown at appendix D.

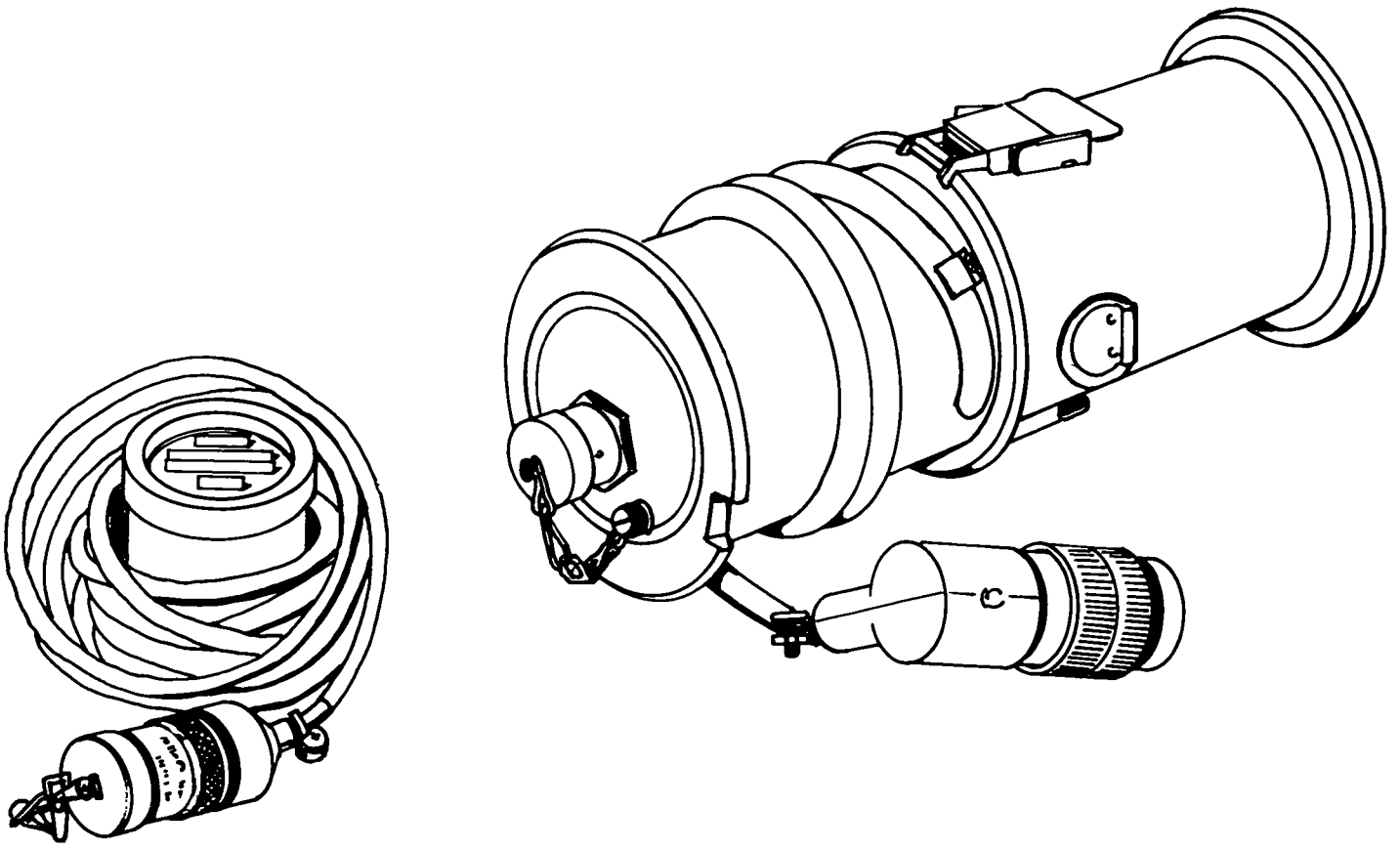


Figure 4-9 (U). Audio Add-on Unit, external view (U).

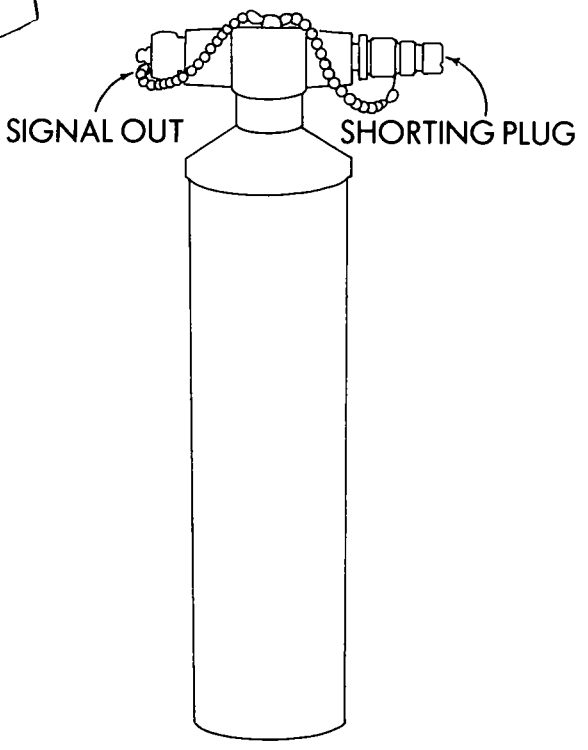


Figure 4-10 (U). MAGID T-4, external view (U).

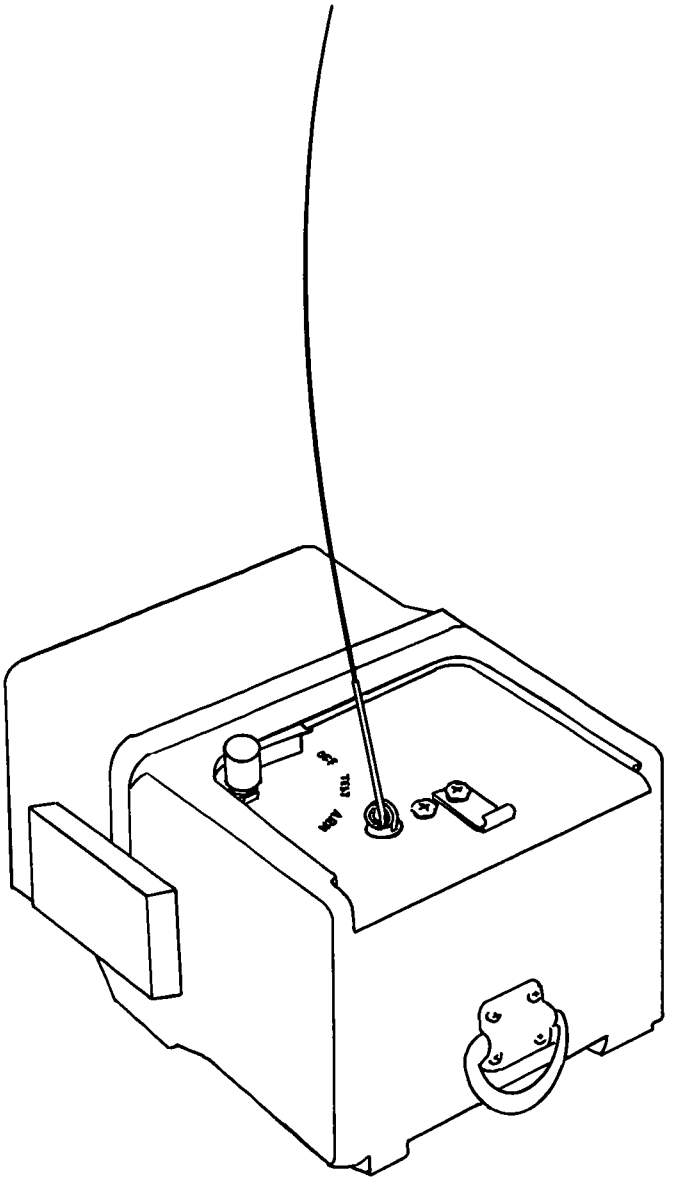


Figure 4-11 (U). DSID III, external view (U).

CHAPTER 5
SYSTEM CONFIGURATION

Section I. SENSOR FIELD DESIGN

5-1. (U) System Use

a. The UGS surveillance system may be employed in many different ways to support combat operations. The sensors have tactical application in offensive operations, defensive operations, and special surveillance missions.

b. In each application sensors are used essentially to obtain information of enemy activity. Enemy activity expected and the type information desired influence the design of the sensor fields. Sensor locations should be as close to the enemy route, trail, or suspected target area as possible. They can also be used to cover voids in other surveillance systems which are generally line of sight restricted.

5-2. (U) Seismic Sensor Field

a. A single sensor could conceivably be used to determine if there is enemy activity at a particular point. Such activity causes the sensor to activate continually as long as the activity exists within detection range of the sensor.

b. Two seismic sensors along a route of enemy movement may be used to determine that movement exists, the direction of movement, and to provide data for determining the rate of movement. Sensor spacing along a route depends on the speed of expected movement. Generally, a spacing of 200–300m is adequate for personnel on foot (squad-sized groups), while 500–600m is adequate for single vehicles. This allows sufficient spacing to determine approximate speed.

c. Three or more seismic sensors along a route allow additional evaluations of target speed. This permits a better prediction of target location for artillery or aerial fire support. Sensor spacing is generally the same as discussed in para *b* above.

d. Seismic sensors within a string and others in the same field should be on the same channel with each possessing a different identification code.

5-3. (U) Electromagnetic Sensor Fields

a. A single electromagnetic sensor is used to detect the passage of enemy personnel or vehicles along waterways, trails, roads, and in marshy areas where other type sensors would be less effective. It is used singly to obtain the level of activity nearby or to confirm other type sensor activations.

b. Two or more electromagnetic sensors can be used to establish rate and direction of movement.

5-4. (U) Disturbance Sensing Devices

A single ARFBUOY/NBB sensor system can be used to monitor an area where an intruder is not canalized. Distribution and number of NBB's used in the monitored area can provide both rate and direction of movement.

5-5. (U) Combined Sensor Fields

Various types of sensors are used in the same field to assist in detecting and confirming the presence of an intruder.

a. In a combined field, one acoustic sensor for each of four seismic sensors in a string assists in determining why the seismic sensors were activated. Similarly, when the level of activity in an area is to be obtained through the use of UGS, combinations of sensors which are the least susceptible to non-hostile activations are used. The hand-emplaced MINISID/AAU and the air-emplaced ACOUSID are both combination sensors which identify themselves and provide acoustic information on the same channel. As may be readily seen the acoustic confirmation of an intrusion is particularly useful in evaluating the nature and the extent of activity.

b. The magnetic sensor is used in conjunction with the MINISID to further confirm an intrusion. It detects the presence of ferrous metal like that found in vehicles and weapons. When the MINISID/MAGID are combined as a single sensor, a single activation signal consisting of the sensor's identification code is transmitted. This single activation signal may denote that both seismic activity and ferrous metal have been detected or ferrous metal only when the geophone is disconnected.

c. The electromagnetic sensor although self-contained may be used in a variety of ways to detect

intrusions and thereby confirm other type sensor activations. Its electromagnetic detection field is unaffected by the operation of other types of UGS's. A minimum distance of 100m is required between like electromagnetic sensors to prevent one sensor from interfering with the operation of the other. When employed in conjunction with seismic sensors, its activation concurrent with those of the seismic sensors can be considered as confirmation.

d. Effective surveillance of relatively small areas may be accomplished through the use of seismic and acoustic sensors with a ratio of approximately four to one. The seismic devices are used to detect personnel and other activities in the area of interest and acoustic devices to enhance detailed assessment of the type of activity. In general effective area surveillance requires approximately 30-percent area coverage by sensors when UGS's are the only devices covering the area. This assumes nominal individual sensor coverage is within a 35-meter radius for seismic devices and a 50-meter radius for acoustic devices. Fewer of them are needed if complemented by other surveillance means.

5-6. (U) Operational Life of Sensors

The length of time that individual UGS's will remain operational can be established prior to emplacement. This feature is made possible by an internal timer device that can be adjusted to activate the sensor's self-disable mechanism following operation over a predetermined length of time.

a. The anticipated length of time that UGS's will be required to operate is a major planning consideration for establishing sensor strings and fields. When the operational life requirements of a sensor field are less than the maximum operating life of the sensors, the number of days that the UGS's will be required is estimated and plans are made accordingly. By limiting the operational life of sensors in this manner, planning for the reestablishment of sensor fields and the reuse of the channel identification code combinations is facilitated. Appendix D reflects the minimum to maximum number of operational days available for each sensor.

b. Sensor recovery is another technique used to control the operating life of a sensor field. Recovery operations are normally limited to hand-emplaced sensors.

5-7. (U) Field Limitations

The number and type of devices usable in a sensor field are limited by the monitor channels and operator's capability. The field may also be limited because of other operational considerations as proximity to friendly installations where friendly seismic or acoustic disturbances are detected by the sensors. Maximum effectiveness is achieved from the data of the sensor field when used in conjunction with other intelligence information.

Section II. SELECTION AND SITING OF MONITOR STATIONS

5-8. (U) Selection of Sites

a. Monitor stations are placed at sites which are located on the highest ground possible while still providing concealment and protection for personnel and equipment. If possible, the station should be near the headquarters of the unit being supported to facilitate coordination and reporting.

b. In mountainous or hilly terrain, sensor and monitor locations are usually not line of sight; therefore, relays are required. However, a terrain analysis may provide line of sight with some strings or fields thereby reducing the relay requirements.

c. The radio frequency range is largely dependent on foliage conditions for employment in flat terrain. In dense jungle ground-to-ground transmission may be reduced to a (sensor-to-monitor) range of only 0.4 to 0.5km. In open or lightly wooded terrain, i.e., across rice paddies or grassy fields, the range should average about 5km ground-to-ground. Greater transmission range can be achieved by increasing receiver antenna heights, using towers or trees with remote antenna at the monitor location with sensors on knolls or hillocks, where appropriate.

5-9. (U) Considerations for Use of Relays

Ground or airborne relays may be used to increase range capability (sensor-to-monitor) with severe line of sight limitations. Airborne relays may be used in special situations to provide continuous coverage of the sensor area. Airborne relays require more than one aircraft to allow for refueling. Because of pilot fatigue and aircraft maintenance, additional aircraft are required for 24-hour coverage for extended periods of time. In special cases, where reception using an airborne relay proves inadequate, an airborne monitoring station may be established.

Section III. SYSTEM OPERATIONAL CHECKS

5-10. (U) Operational Checks

Operational checks consist of initial verification that the emplaced sensor is operational and periodic preplanned checks scheduled, as deemed necessary, to verify system operation.

5-11. (U) Hand-emplaced Sensors

When this type sensor is emplaced and prior to activation of the self-disable feature, the sensor should be checked to insure that it is transmitting properly. A radio frequency indicator verifies that the sensor is transmitting. Once this fact has been established, the emplacement team should make radio contact with the monitor station. That station then coordinates the sensor activation with the emplacement team to verify the sensor-monitor link. At this time the self-disable mechanism may be activated as outlined in the appropriate technical publication.

5-12. (U) Air-emplaced and Artillery-delivered Sensors

Two procedures can be used for verification of air-emplaced and artillery-delivered sensors. The first involves aircraft overflying the sensor at low altitude and the other the firing of artillery or other weapons in the vicinity of the sensor. Either method causes the sensor to activate and permits verification of the sensor-receiver radio link. Another method is through coordination with the tactical units supported to have friendly patrols in close proximity to a string or field walk in close proximity to verify that the sensor-monitor loop is functioning. During the hours of darkness and through radio contact with the patrols this procedure could also be helpful to the patrol in determining location.

CHAPTER 6
ORGANIZATION

6-1. (U) General

The characteristics of UGS systems, the limited assets, and the varied intelligence requirements of each echelon (company through division) dictate that assets, both personnel and equipment, be controlled at the division level. Therefore, an UGS platoon (fig. 6-1) is established at division level to provide all monitoring, supervision of emplacement, logistical support, and overall control throughout the division.

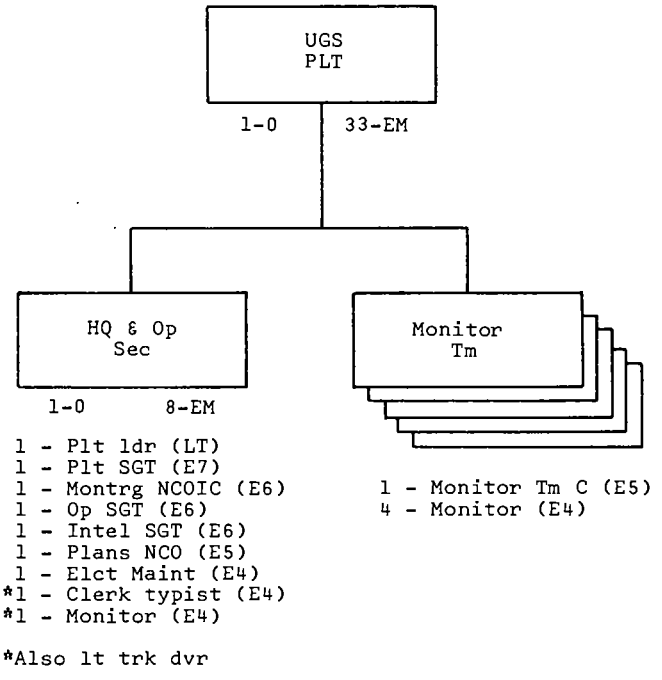


Figure 6-1 (U). Division unattended ground sensor platoon (U).

6-2. (U) Headquarters and Operations Section

The platoon's headquarters and operations section assist the division G2 in planning, monitoring, and controlling all the divisional UGS assets as well as being the control element for the monitoring team. They also provide an organizational maintenance capability used primarily for check-out of sensors prior to emplacement. Requisitioning and exchange or turn-in of malfunctioning equipment are functions also performed by this section. Training of all platoon personnel and normal administrative functions are performed by the headquarters and operations section.

6-3. (U) Monitor Teams

The five monitor teams are authorized to support the brigade and battalions on an "as needed" basis. Since five men are required as a minimum-sized team capable of monitoring any system configuration on a 24-hour basis, the team is not fragmented except when absolutely necessary to establish additional monitor sites and then only for a very short time (less than 36 hours). The team chief, upon orders, reports to and supports the brigade or battalion S2 in all activities, planning through monitoring, associated with the employment of UGS's.

6-4. (U) Monitoring

All monitoring at the division is performed by personnel of headquarters and operations section as an additional duty.

6-5. (U) Duties of Personnel

a. Platoon leader (LT).

(1) Performs as a special staff officer.

(2) Plans, recommends, and coordinates the employment of sensors within the division.

(3) Coordinates channels and identification codes used within the division.

(4) Recommends areas to employ division sensors to support the division's mission.

(5) Coordinates monitoring of sensors throughout the division.

(6) Keeps division G2 informed of all sensor-derived information.

(7) Maintains an updated overlay showing all implanted sensors and expected expiration of sensors throughout the division. These locations are in 8-digit coordinates and forwarded to higher headquarters as required.

(8) Maintains overlay showing enemy activity throughout the division as pertains to sensors. This information is posted on G2 overlays.

b. Platoon sergeant (E7).

(1) Assists the platoon leader in performing his duties.

(2) Assumes command in the platoon leader's absence.

c. Monitoring NCOIC (E6).

(1) Keeps the platoon leader informed of monitoring capability using division systems.

(2) Coordinates and directs the setting up of division monitoring sites.

(3) Coordinates air emplacement and air readout for division sensors.

d. Operations sergeant (E6).

(1) Coordinates all area systems monitored at division to include BASS and LORAN.

(2) Prepares all sensor-related reports for submission to higher headquarters except those pertaining to supply and maintenance.

(3) Maintains channel and tone code management for the division.

e. Intelligence sergeant (E6).

(1) Analyzes sensor activations and maintains historical records of sensor fields.

(2) Maintains sensor overlay for G2.

f. Plans NCO (E5). Assists the operations sergeant in planning for sensor employment throughout the division.

g. Electronic maintenance man (E4).

(1) Supervises and performs organizational maintenance on all UGS monitoring and relay equipment.

(2) Inspects and checks out all sensors received for emplacement and those returned from subordinate units for turn-in.

(3) Assists the supply clerk in identifying items and components within the system.

h. Clerk typist (E4).

(1) Requests, issues, and stores sensor equipment for the division.

(2) Prepares all reports pertaining to supply and maintenance for submission to higher headquarters.

i. Monitor team chief (E5).

(1) Selects the actual monitoring sites.

(2) Maintains records and prepares emplacement requests and reports.

(3) Coordinates local security of the team with the supported unit.

(4) Coordinates all team activity with the supported unit.

(5) Reports information obtained from the sensors to the supported unit and brigade and/or division monitoring element.

(6) Establishes communications for the team.

j. Monitor (E4).

(1) Operates monitoring site equipment.

(2) Records and reports all information obtained from the sensors.

CHAPTER 7

SYSTEM MANAGEMENT

Section I. CONTROL

7-1. (U) General

a. Sensor management and general employment guidance are a command responsibility. The sensor system must provide accurate and timely information at the echelon where ready reaction forces can act decisively to take full advantage of the information. The system functions tactically from small independent patrols through divisions, and in management channels from the lowest command echelon throughout the theater of operations. Management includes all aspects of combat support and combat service support necessary to sustain and maintain the system. Coordination and supervision of sensor operations are the staff responsibility of intelligence officers at all echelons.

b. Selection of sensor locations, methods of employment, emplacement, and actions to be taken based on sensor information are normally delegated to battalion and/or brigade commanders. Monitoring of UGS's at the battalion level greatly reduces reaction time and enables screening of sensor information and correlation of data from other surveillance resources prior to introduction of the information into the brigade and higher intelligence systems. Brigade and division may monitor battalion sensor fields and often do, as well as monitor their own. Brigade and division fields are emplaced to extend the area under surveillance or to supplement and reinforce the fields of the battalion.

c. At division and separate brigade, requests from subordinate elements for sensor support are consolidated and assets allocated based on priorities established by the commander. Elements below division and separate brigade submit requests for sensor support through normal intelligence channels. A report of sensor emplacement is submitted by the emplacing unit to the division control element by the most expeditious means.

d. Using units maintain information on all sensors to include type, location, time of emplacement, frequency/code, expected service life, and identification of those sensors employed in the self-disable mode.

7-2. (U) Communications

a. The existing communications system (command, area, organic) is employed for dissemination of information gained from employment of sensor devices.

b. Employment of specific sensors and relays is determined by the availability of frequencies in respective corps' areas of operations. The theater establishes a listing of those frequencies/codes that may not be used within proximity of corps' boundaries.

c. Overall sensor frequency management is determined at theater level. Normally, frequency management below this level is based on geographical area since this eliminates frequency interference problems when units are required to move to different areas.

d. Below theater level frequency management for sensors is under the general staff supervision of the G2/S2 and the special staff supervision of the signal officer for issuing and allocating individual frequencies throughout the command.

7-3. (U) Intelligence

a. In planning operations the employment of sensor devices is included in the overall information collection plan at all echelons. The G2/S2 has primary staff responsibility for the employment of sensors.

b. Sensor devices should be employed to complement other intelligence collection means. Because of the stringent line of sight limitation of UGS's and other ground surveillance devices, skillful employment of UGS's, relays, and monitoring equipment may be the only means of gaining critical real time information.

c. All information should be analyzed in conjunction with current friendly activities and other collateral intelligence. This is normally done at battalion level to insure timely, accurate intelligence. The intelligence gained is highly perishable and requires immediate action in many instances.

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d. Dissemination will not normally be a problem at battalion level since this is the level where immediate action can be taken. This is possible because of the simultaneous receipt of the sensor information derived by the fire support and intelligence elements. Intelligence developed should be handled as spot reports or situation reports on the operations/intelligence nets the same as other intelligence.

e. Provisions for security should be made for destruction of monitoring equipment in the event capture is imminent and reports of jamming, equipment loss, or compromise should be submitted through intelligence channels by the fastest means available. All devices that are not to be recovered should be set on self-disable at time of emplacement.

7-4. (U) Combat Support

a. The success of sensor devices depends, to a large degree, upon the ability of the employing force to deliver timely and effective fires upon the area in which a threat is detected. The methods of employing the fire support, in conjunction with sensors, are limited only by the commander's ingenuity; however, detailed planning and close coordination between the commander and the fire support elements are essential.

b. Sensor devices which can be emplaced accurately offer the distinct advantages of permitting the delivery of timely and effective unobserved fires into the target area. This can be accomplished by planning artillery concentrations on or in the vicinity of the sensors. These type missions should not be limited to ground-based artillery as there may be many situations where it is more advantageous to use aerial artillery, attack helicopters, naval gunfire, or tactical air support.

c. Reports from sensors which have not been located accurately may require supplemental reports from radar and/or other surveillance devices prior to the delivery of unobserved fires.

d. When a unit commander desires to have sensors emplaced by air or artillery, he will forward a request to the delivery unit, through established channels, specifying the types of sensors, transmitting channels and identifying tone codes, emplacement locations, and times to emplace.

Section II. MAINTENANCE AND SUPPLY

7-5. (U) Maintenance

a. Operator/organizational maintenance will be performed by the UGS platoon personnel under the supervision of the UGS platoon sergeant. Preoperational test and maintenance will be performed in accordance with technical manuals and/or manufacturer's technical publications. Maintenance at the user level is normally restricted to:

(1) Changing and replacing batteries in receivers and sensors, as required.

(2) Replacing defective minor components such as light display elements, fuses, earphones, antennas, and external cables.

(3) Performing all functions required to activate equipment and select mode.

b. Operator/organizational maintenance of the artillery-delivered sensors will consist of receipt, temporary storage, and visual inspections.

7-6. (U) Maintenance Logs and Spare Parts

a. Equipment logs will be maintained as directed by local standing operating procedures.

b. Spare parts at the user level consist of replacement batteries, fuses, and cable assemblies.

7-7. (U) Supply

Existing supply procedures for sensitive materials will be used. Sensors and associated equipment will be controlled. Maximum use of direct exchange will be made through the use of operational readiness floats maintained at the division support command and under control of the division UGS officer.

APPENDIX A

REFERENCES

A-1. (U) Army Regulations (AR)

310-25	Dictionary of U.S. Army Terms (Short Title: AD).
310-34	Equipment Authorization Policies and Criteria, and Common Tables of Allowances.
310-49	The Army Authorization Documents System (TAADS).
570-2	Organization and Equipment Authorization Tables—Personnel.
710-2	Materiel Management for Using Units, Support Units, and Installations.
725-50	Requisitioning, Receipt and Issue System.
735-35	Supply Procedures for TOE and TDA Units or Activities.
750-1	Maintenance Concepts.
750-5	Organization, Policies, and Responsibilities for Maintenance Operations.
750-50	Use of Controlled Cannibalization as a Source of Repair for Supply Augmentation.

A-2. (U) Field Manuals (FM)

1-15	Aviation Battalion, Group, and Brigade.
1-80	Aerial Observer Techniques and Procedures.
1-100	Army Aviation Utilization.
1-110	Armed Helicopter Employment.
5-1	Engineer Troop Organizations and Operations.
6-20-1	Field Artillery Tactics.
6-20-2	Field Artillery Techniques.
6-120	Field Artillery Target Acquisition Battalion and Batteries.
6-121	Field Artillery Target Acquisition.
6-140	Field Artillery Cannon Battalions and Batteries.
7-10	The Rifle Company, Platoons, and Squads.
7-20	The Infantry Battalions.
17-1	Armor Operations.
17-15	Tank Units, Platoon, Company, and Battalion.
17-30	The Armored Brigade.
17-36	Divisional Armored and Air Cavalry Units.
17-95	The Armored Cavalry Regiment.
21-50	Ranger Training and Ranger Operations.
21-75	Combat Training of the Individual Soldier and Patrolling.
24-1	Tactical Communications Doctrine.
29-3	Direct Support Supply and Service in the Field Army.
29-10	Supply Management in the Field Army.
29-10-1 (Test)	The Field Army Supply Management System.
29-30	Maintenance Battalion and Company Operations in Divisions and Separate Brigades.
29-45	General Support Supply and Service in the Field Army.
29-45-1 (Test)	General Support Supply and Service in the Field Army.
30-5	Combat Intelligence.

30-9	Military Intelligence Battalion, Field Army.
30-16	Technical Intelligence.
30-20	Aerial Surveillance/Reconnaissance, Field Army.
31-2 (Test)	Surveillance, Target Acqusition and Night Observation (STANO) Doctrine.
31-10	Denial Operations and Barriers.
31-16	Counterguerrilla Operations.
31-18	Long-Range Reconnaissance Ranger Company.
31-21	Special Forces Operations—U.S. Army Doctrine.
31-23	Stability Operations—U.S. Army Doctrine.
31-25	Desert Operations.
31-36 (Test)	Night Operations.
(C) 31-40	Tactical Cover and Deception (U).
31-55 (Test)	Border Security/Anti-Infiltration Operations.
31-60	River-Crossing Operations.
31-72	Mountain Operations.
31-81 (Test)	Base Defense.
31-100 (Test)	Surveillance, Target Acquisition, and Night Observation (STANO) Operations.
(C) 32-5	Signal Security (SIGSEC) (U).
(S) 32-10	U.S. Army Security Agency in Support of Tactical Operations (U).
(C) 32-20	Electronic Warfare (Ground Based) (U).
(S) 32-20A	Electronic Warfare (Ground Based) (U).
54-2	The Division Support Command and Separate Brigade Support Battalion.
57-1	U.S. Army/U.S. Air Force Doctrine for Airborne Operations (AFM 2-51).
57-35	Airmobile Operations.
57-38	Pathfinder Operations.
61-24	Division Communications.
61-100	The Division.
100-5	Operation by Army Forces in the Field.
100-26	The Air-Ground Operation System.

A-3. (U) Technical Manuals (TM)

TM 11-5820-790-12	Operator's and Organizational Maintenance Manual, Radio Frequency Monitor Set AN/USQ-46A; Power Supply Group OP-63/USQ-46 and Mounting Base, Electrical Equipment MT-4261/USQ-46.
TM 11-5895-725-12	Operator's and Organizational Maintenance Manual: Recorder, Signal Data RO-376/USQ.
(C) TM 11-5895-745-15	Operator's, Organizational, DS, GS, and Depot Maintenance Manual, Detecting-Transmitting Set, Radio AN/GSQ-157 (U).
TM 11-5895-750-12	Operator's and Organizational Maintenance, Including Repair Parts and Special Tool Lists: Antenna Group AN/USA-32 and Antennal AS-2549/USQ.
TM 11-5895-751-12	Operator's and Organizational Maintenance Manual: Repeater Sets, Radio AN/GRQ-16(V) 1, 2, 3, and 4.

A-4. (U) Miscellaneous

(C) DA Pam 71-4	Operational Concepts for the Army Unattended Ground Sensor Systems (U).

APPENDIX B
EMPLACEMENT TECHNIQUES

(U) Unattended ground sensors may be emplaced in a target area by one of three delivery methods: hand-emplaced, air-emplaced, or artillery-delivered. The method used varies from mission to mission, depending upon such factors as the tactical situation, mission, terrain, type sensor to be used, and delivery assets.

B-1. (U) Hand Emplacement

This is the most effective method of emplacing sensors, because the emplacement team is on the ground and able to modify the emplacement plan as the situation demands. The emplacement team is also able to give 8-digit coordinates for sensor locations and place equipment properly to insure maximum coverage of the target area and to camouflage the equipment at the target site. Hand emplacement also facilitates a greater array of sensor types (seismic, magnetic, disturbance, electromagnetic, and acoustic) for better confirmation of sensor activation and discrimination of nonmilitary targets. If at all possible sensors should be hand-emplaced, since more control can be exerted and fewer uncontrollable variables enter the emplacement mission.

B-2. (U) Air Emplacement

Air emplacement represents a highly mobile and accurate method of delivering sensors into an area which would otherwise remain inaccessible to friendly units. The type of aircraft used to deliver the sensors varies. In most cases it is the UH-1 (HUEY). However, almost any aircraft from an O-1 (BIRDDOG) to the CH-47 (CHINOOK) to a fast moving F-4 (PHANTOM) may be used.

a. Using the UH-1 the sensor crew normally consists of a spotter, a feeder, and a bombardier. This is in addition to the normal aircraft crew.

(1) All three members of the sensor crew sit at the right side of the aircraft (fig. B-1). This is done for better observation by the bombardier and spotter, and facilitates supplying the bombardier by the feeder. The feeder (No. 1) is seated behind the pilot (right side) in position so he is able to pass the sensor to the bombardier. In addition to passing sensors to the bombardier, the feeder is also responsible for insuring proper sequence of sensors dropped along with recording their channel and tone code.

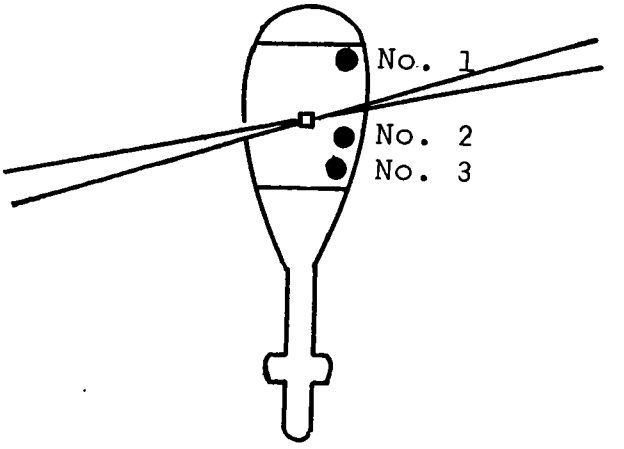

Figure B-1 (U). Sensor crew positions (U).

(2) The bombardier (No. 2) may sit on the floor or sideways in the passenger's seat, facing out. He must also be in a position to see the ground ahead of and below the helicopter. Either on command from the pilot or on his own (this varies depending upon the proficiency of both the pilot and the bombardier), the bombardier will drop the sensor from the aircraft to strike the target area.

b. Several sighting methods are being used or under examination at present. The two methods used extensively are both reference methods.

(1) The first is a pilot reference (fig. B-2). A vertical line is taped on the lower plexiglass windscreen with horizontal reference points spaced evenly along the vertical line. The vertical reference line is positioned directly in front of the pilot using the control stick as a guide. After several practice drops, the pilot is able to adjust his point of aim accordingly. Once the pilot has adjusted his point of aim, he must fly at that same altitude and airspeed on the actual drop. As he nears the target, the pilot gives the bombardier a countdown and final release command.

(2) The second method is the bombardier's reference method which, as experience increases, is more reliable. The bombardier uses a reference point

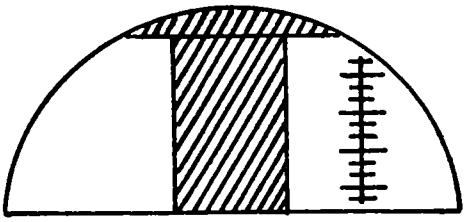

Figure B-2 (U). Pilot reference (U).

on the helicopter skid as his aiming point. No definite point can be given as an absolute reference, because it varies from bombardier to bombardier. Even when this second method is used, the pilot's sight helps to insure that a straight line pass is made over the target area (fig. B-3).

c. The last member of the drop crew is the spotter (No. 3). His job is to record the exact location where each sensor strikes the ground. This is most difficult, especially when flying over heavily wooded terrain. To aid the spotter, there are several measures that can be taken to increase accuracy. One is to attach a smoke or a CS gas grenade to the aft section of a sensor. The pin is pulled on the grenade and the spoon held down until the sensor has been launched from the aircraft. When the sensor is implanted, a white cloud of smoke (gas) is visible from the air. At this point, the spotter marks the location on his map and takes a hand-held photo of the location. Once the entire mission has been completed and the crew has returned to base, the camera film is turned over to the imagery interpreter and a comparison made with existing strip photos. In this manner exact 8-digit coordinates are obtained.

d. Another consideration would be to have a forward observer either replace the spotter and perform his duties or have the forward observer follow in a chase ship. In either case once a string of sensors has been dropped and the data recorded, the forward observer can adjust artillery fire into the target area.

B-3. (U) Artillery Delivery

This mode of sensor delivery has vast potentials. The technique requires less planning and coordination than airdrop and is not contingent upon a permissive air environment. Another advantage is the ability to place sensors into a target area and be able to bring pinpoint fire into the area at once. A commander has the ability to fire sensors into a suspected enemy-used area, confirm or deny his suspicions and, if required, react with the same means with which that sensor was delivered.

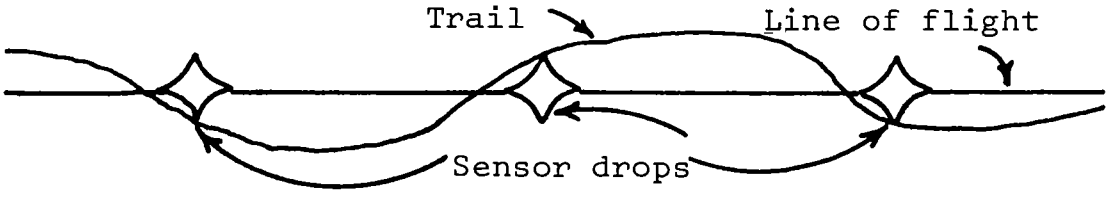

Figure B-3 (U). Flight path reference (U).

APPENDIX C
DISPLAY INTERPRETATION

C-1. (U) Introduction

This appendix covers the techniques of manual plotting and procedures for interpretation of recordings from the Signal Data Recorder RO-376/USQ (event recorder) and the BASS III sensor display unit (XT plotter).

C-2. (U) Sensor Fields

a. The illustration (fig. C-1) is a type sensor field. There are seven sensors in this field and their locations are indicated by the encircled numeral. This sensor field employs three strings of sensors. They are: Sensors No. 1, 2, and 3; Sensors No. 3, 4, and 5; and Sensors No. 3, 6, and 7. A sensor may be used in more than one string. Note in figure C-1 that Sensor No. 3 is used in more than one string.

b. In figure C-2 dotted circles, inclosing the sensor, illustrate the detection range for walking personnel. In this example the composition of the soil affords each sensor an approximate 30-meter detection radius (60-meter diameter). A reduced width (meters along the trail) for detection results from emplacement of sensors off the trail so the location of each sensor is not compromised. The width of detection areas (trail) for purposes of this illustration is approximately 50m for each of the sensors. In figure C-1 note that the distance between sensors is shown also.

C-3. (U) Interpretation of Manually Plotted Activities

If the portatale operator is to understand and be able to interpret sensor activity recorded by the event recorder or the XT plotter, he should first possess a working knowledge of the techniques used to interpret manually plotted activities occurring in the sensor field. To illustrate interpretation techniques for manually plotted data, the sensor field shown in figure C-2 will be used.

a. A 10-man patrol entered the sensor field at 0948 hours and negotiated the trail from Sensor No. 1 to Sensor No. 3. The identification code of each sensor is spaced at 10-second intervals. The portatale operator's manually plotted log sheet is reproduced at figure C-3. Note that elapsed time between beginning activation signals on Sensor

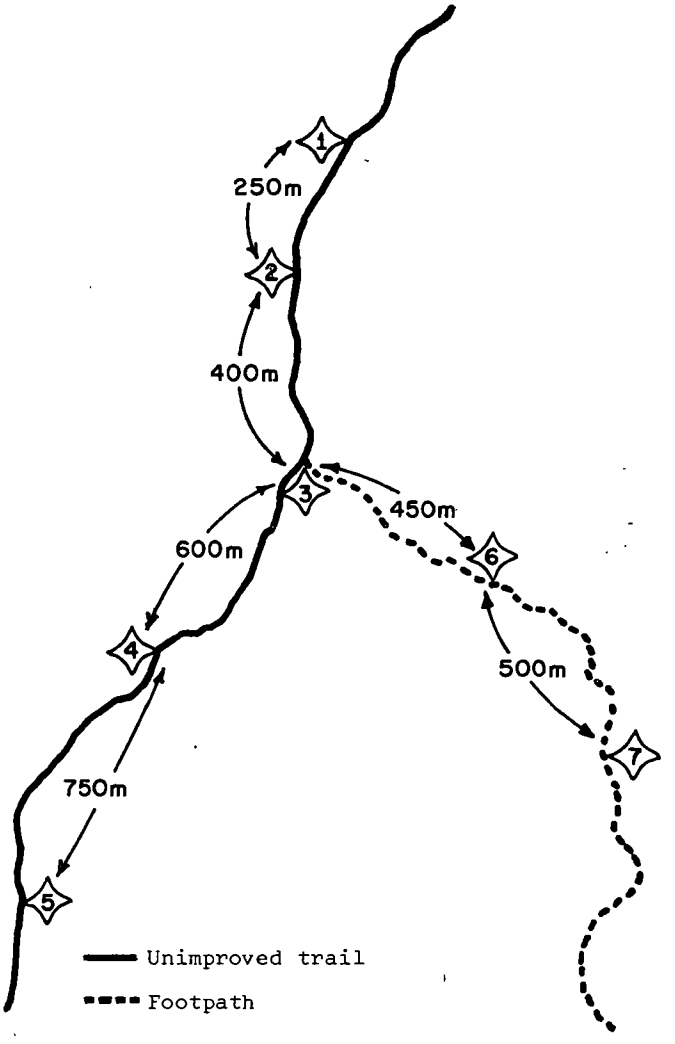

Figure C-1 (U). Type sensor field (U).

No. 1 and beginning activation signals on Sensor No. 2 is approximately 3.5 minutes. Since the two sensors are separated by a distance of 250m along a trail, the operator needs to divide the distance (250m) by the time (3.5 min) to obtain the rate of movement (Rm) between the two sensors, e.g.:

$$\frac{250}{3.5} = 71 + \text{meters a minute}$$

*See figure C-19 for table to convert meters a minute to kilometers an hour and/or miles an hour.

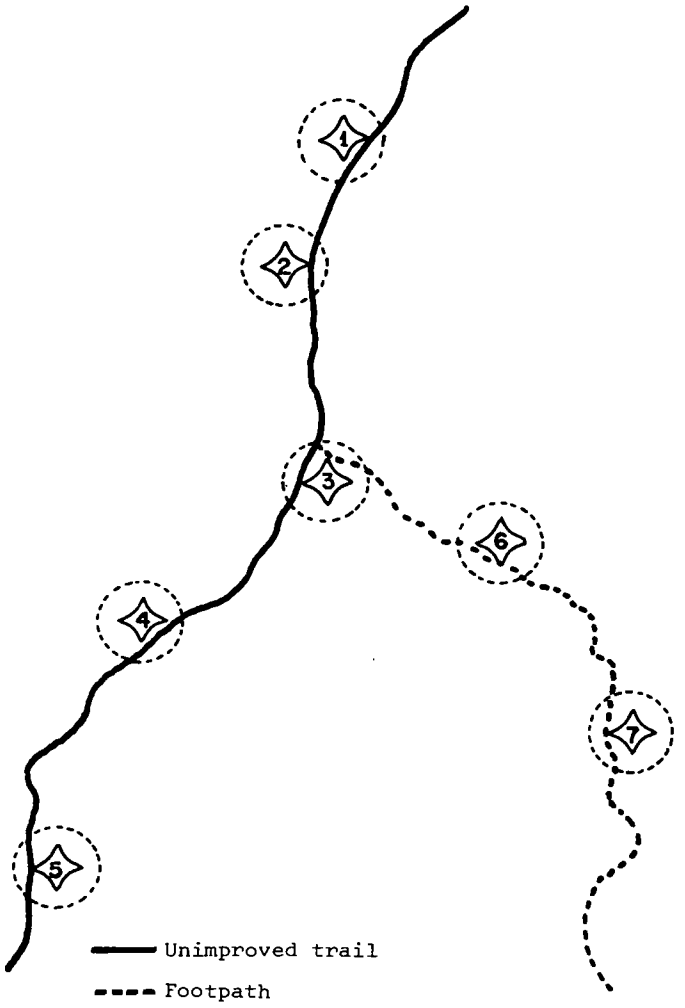

Figure C-2 (U). Sensor field capabilities for detection of walking personnel (U).

b. With the direction and Rm established, the operator is now able to predict/fix location of moving personnel in relation to elapsed time, i.e., the operator is aware that Sensor No. 3 is separated from Sensor No. 2 by a distance of 400m. To predict arrival time at Sensor No. 3, the operator divides the distance between sensors by the Rm.

Distance to be traveled—400 meters

Rate of movement—71+meters a minute

$\frac{400}{71}$=5.63 minutes or 5 minutes and 40 seconds

c. Additional information to be derived pertains to the size and/or length of the moving target and the number of moving objects involved.

(1) The operator must solve the following mathematical equation to attain length of column data:

Rm × Mdz − Tddz = length of moving target

Legend:

RM —rate of movement in meters a minute
Mdz —minutes in detection zone (i.e., duration of continuous activations from a specific sensor)
Tddz—trail distance in detection zone (meters)

(*a*) Each unknown factor in the equation is known to the operator.

Rm —71+ meters a minute (previously established by the operator)
Mdz —1.33 minutes in detection zone. (Operator refers to his log (fig. C-3) to obtain length of time that movement occurred in each sensor's detection zone. The Mdz for Sensors No. 1 and 2 is the same, i.e., 80 seconds. When there are Mdz differences, the operator uses the Mdz for each sensor and solves each equation separately.)
Tddz—50 meters (length of the passageway for personnel through the sensor's detection zone).

(*b*) The equation is solved as follows:

71×1.33−50=
94−50=44 meters

	SENSOR IDENTIFICATION							
TIME	#1	#2	#3	#4	#5	#6	#7	REMARKS
0900								
1								
2								
3								
8	IIIII							
9	III							
0950								
1		III						
2		IIIII						
3								
4								
5								
6								
7			IIIII					
8			IIII					
9								

Figure C-3 (U). Sensor activation signals manually plotted on the portatale operator's log (U).

(2) To estimate the number of personnel marching in a column 44m long, the operator divides the length of the column by the standaid troop interval under tactical conditions (5 meters) and then adds 1 to obtain the estimated number of personnel, e.g., $\frac{44}{5}+1=8.8$ plus $1=9.8$ or 10 individuals.

d. Unobserved fires are frequently planned in conjunction with operations involving UGS's (fig. C–4). It is apparent that the effectiveness of unobserved fires is contingent upon the proficiency of the portatale operator and the speed and accuracy in which he obtains the foregoing data. The manner and procedure the operator follows to attain time on target (TOT) fire is prescribed by unit standing operating procedures.

C–4. (U) Vehicular Movement

Vehicular movements within the sensor field create a different set of circumstances that must be recognized by the portatale operator. Vehicular movement increases the Rm which in turn reduces the time available between sensors for the portatale operator's reaction. The detection zone for seismic sensors increases greatly and depending upon soil conditions, the detection radius of a sensor may at times exceed 400m for tanks and heavily loaded large trucks. Conversely, light vehicles traveling with low-pressure tires often elude detection at distances as close as 150m. To illustrate the differences in interpretation techniques, when vehicular traffic is involved instead of personnel movement, refer to the sensor field depicted in figure C–1. Figure

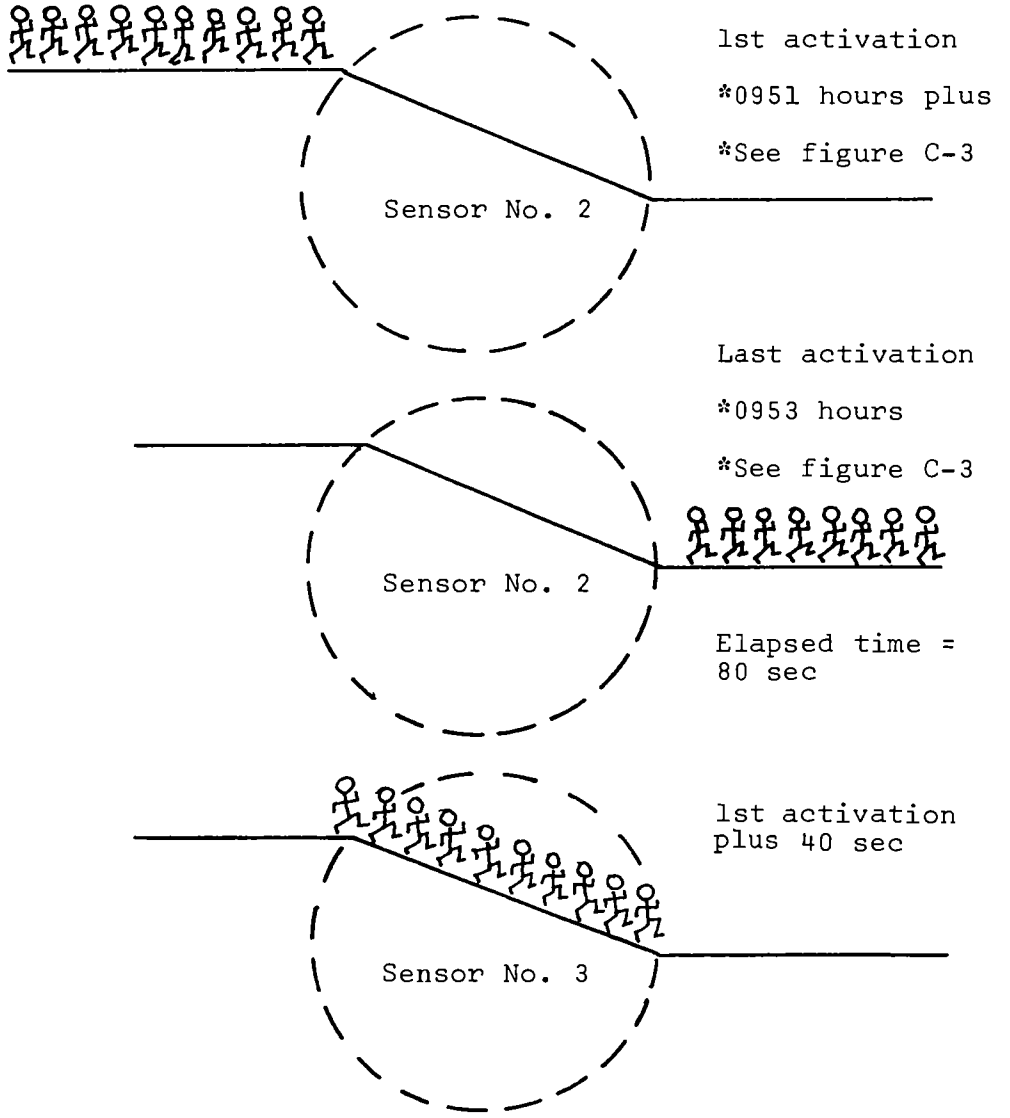

Figure C–4 (U). Determination of optimum time for unobserved fire (U).

C-5 illustrates the standard 300-meter seismic sensor detection range for vehicles and annotates the Tddz.

a. At 2130 hours movement was detected by Sensor No. 1. Since then, the portatale operator has been busily engaged in logging sensor data involving Sensors No. 1 through 4. The operator's log is shown at figure C-6.

b. A notable indicator is logged by the operator during the first minute of activity. A moving target advances from the edge of the detection zone for Sensor No. 1 to the edge of the detection zone for Sensor No. 2 in less than 1 minute if sensor activation signals are not caused by a malfunction or a nonhostile phenomena. While the operator is aware that the trail distance between detection zones of

Tddz (meters)

Sensor No.	Veh	Pers
1	650	50
2	700	50
3	750	50
4	800	50
5	850	50

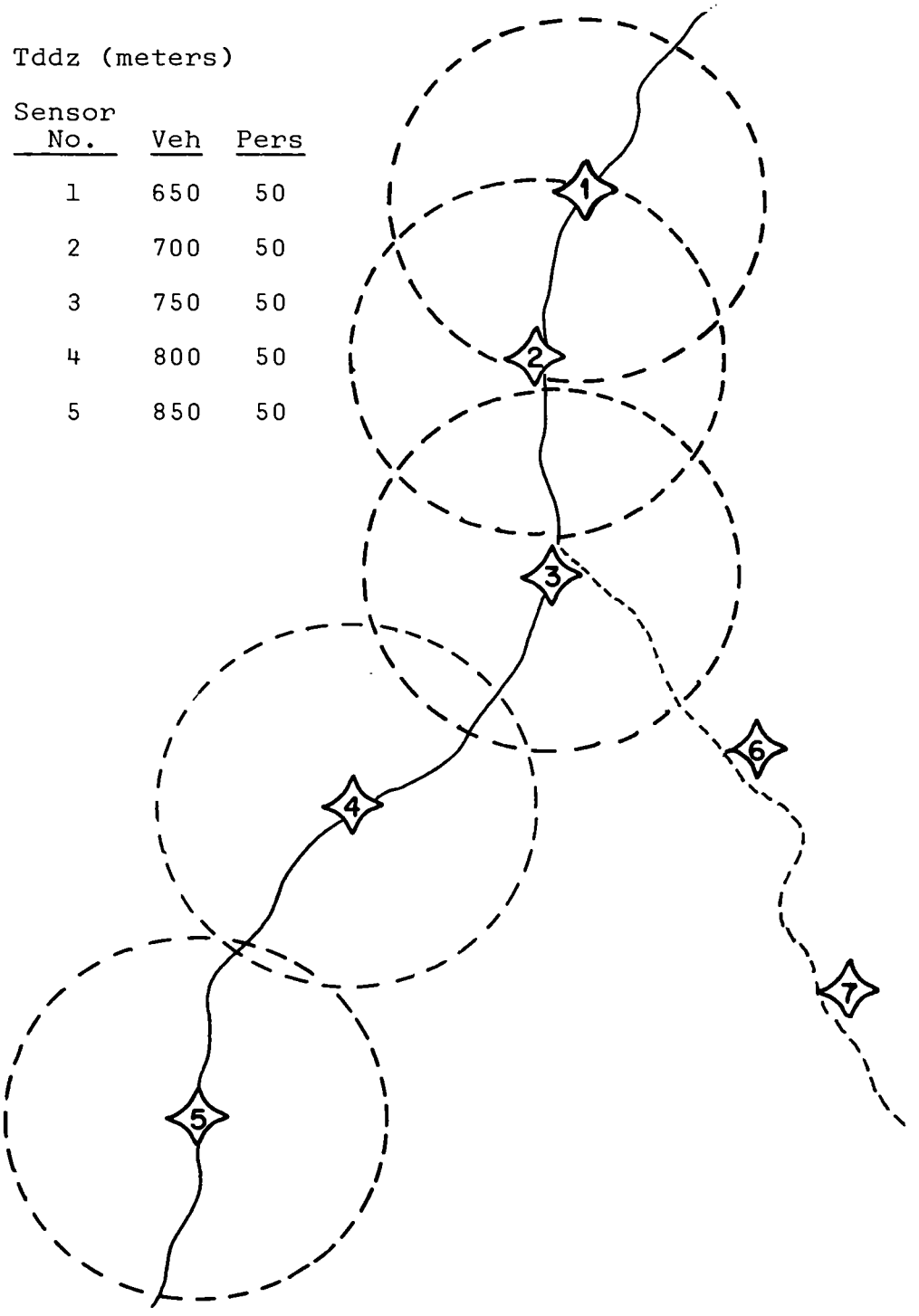

Figure C-5 (U). Sensor field capabilities for detection of personnel and vehicular traffic (U).

Sensors No. 1 and 2 may exceed 250m, the Rm (250m each 50 sec) is equivalent to 300m a minute. Consequently, the operator can be reasonably sure that the moving target is vehicular in nature since personnel on foot seldom move except for short distances at a rate exceeding 110m a minute. (See fig. C–19.)

	SENSOR IDENTIFICATION							
TIME	#1	#2	#3	#4	#5	#6	#7	REMARKS
2100								
1								
2								
3								
8								
9								
2130	IIIII	I						
1	IIIII	IIIII						
2	III	IIIII	IIIII					
3		IIII	IIIII					
4			IIIII					
5				IIIII				
6								
7								
8								
9								
2140								

Figure C–6 (U). Sensor activations manually plotted on the portatale operator's log (U).

c. During the third minute the operator notes that the moving target enters the detection zone of Sensor No. 3 and then leaves that zone for Sensor No. 1. The Tddz of Sensor No. 1 is approximately 650m (map measurement). Time for the moving target to travel these 650m is 2.5 minutes. The operator then notes that movement detected by Sensor No. 2 ceases after 2.67 minutes. The Tddz of Sensor No. 2 is 700m. The mathematical equation for determining the length of the moving target is Rm×Mdz−Tddz. (Mdz and Tddz differ; therefore, separate equations are solved.)

(1) Legend for Sensor No. 1:

Rm—300 meters a minute

Mdz—2.5 minutes in the detection zone

Tddz—650 meters trail distance through the detection zone

Length of moving target=300×2.5−750
=750−650
=100 meters

(2) Legend for Sensor No. 2:

Rm—same as Sensor No. 1

Mdz—2.67 minutes in the detection zone

Tddz—700 meters trail distance through the detection zone

Length of moving target=300×2.67−700
=800−700
=100 meters

(3) Length of moving target (unknown number of vehicles) is confirmed by both sensors at 100m.

d. Under tactical conditions with various types of vehicles and road conditions, the interval maintained between vehicles during a road march is much less standard than with walking troops. Consequently, when sensors employing seismic detection techniques are used, the number and kinds of vehicles are unknown factors that must be considered in planning capabilities for the sensor field. These unknown factors may require confirmation from other sensory devices or be established through order of battle (OB) intelligence. In planning the sensor field in figure C–1, vehicular movement along the trail monitored by Sensors No. 1 through 5 is anticipated. Consequently, Sensor No. 4 is equipped with an external sensor and the operational mode of the combination sensors is selected to enhance confirmation of vehicles and under optimum conditions yields a count of vehicles in a column. MAGID is satellited on MINISID when the selected mode of operation requires both magnetic and seismic detections simultaneously before registering an activation.

(1) The portatale operator is aware that the trail distance between Sensors No. 3 and No. 4 is 600m or 2 minutes travel time. To anticipate when the moving target will arrive at the location of Sensor No. 4, the operator adds 2 minutes to the moving target's arrival time at Sensor No. 3 (trail junction).

(2) Arrival time at Sensor No. 3 is achieved by dividing in half the time required to travel the Tddz of Sensor No. 3 and adding that sum to the time of initial detection, e.g., one-half of $\frac{\text{Tddz}}{\text{Rm}}$=amount of time to travel one-half Tddz of Sensor No. 3 or ½×750/300=75/60 or 1.25 minutes. If initial activation occurred at 2132 hours, arrival time is 1.25 minutes later.

(3) Anticipated arrival time at Sensor No. 4 is arrival time at Sensor No. 3 plus 2 minutes, e.g., 2135.25 hours.

(4) Note that the operator logged only four activations for Sensor No. 4 (fig. C–6). These activations indicate the MAGID being activated on four occasions while simultaneous seismic activity is being detected by the MINISID. The interpretation is that the moving column 100m in length

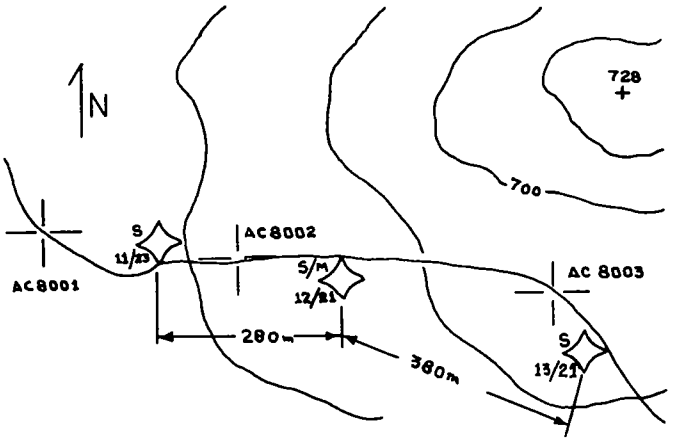

Figure C-7 (U). Implant sketch (U).

contains four vehicles unless two or more vehicles were within the detection zone of the MAGID at the same time. (When this occurs, the detected movement is sensed as one target.)

(5) If the operational mode is set for an external sensor only, the operator would log four separate activations. The operator's log would appear the same as illustrated by figure C-6 and the interpretation would be the same.

C-5. (U) Sensor Activation Techniques

Another operator technique used to interpret manually plotted sensor activations involves the preparation and use of a prediction graph for each sensor string. To construct the prediction graph, the operator uses the sensor implant sketch depicting the sensor locations and the distances between sensors. If unobserved fires are planned in conjunction with the sensor string, the operator also plots the location of the artillery concentration points and determines the distance between these points and the sensors. The sketch which can be equated to an enlarged overlay of the area should appear similar to the illustration in figure C-7.

a. In preparing the prediction graph, the bottom line represents distance and is equally divided in 100m increments. (See fig. C-8.) The solid lines running from top to bottom represent sensor locations as taken from the implant sketch (fig. C-7). (Sensor symbol 11/21 represents identification code and channel, respectively.) Artillery concentrations (AC 8001, AC 8002, etc.) are represented by broken lines and are registered in the same manner as sensors. Artillery concentration points and sensor

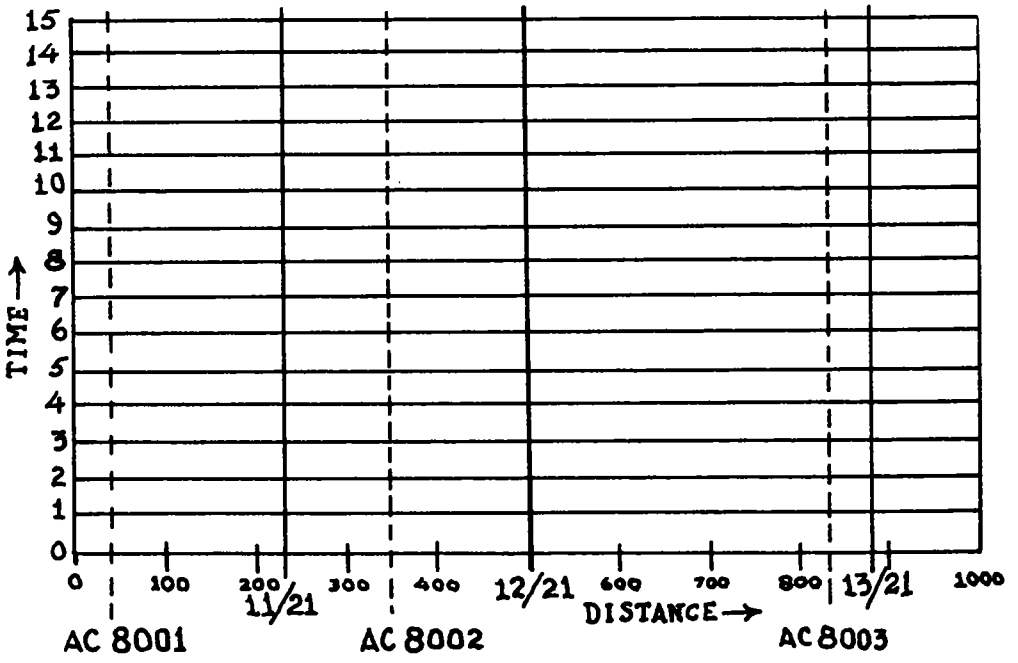

Figure C-8 (U). Operator prepared prediction graph (U).

locations are entered on the graph reading from left to right as they appear on the implant sketch. Increasing time is displayed on the graph from bottom to top and is shown in minutes.

b. To use the prediction graph (fig. C–8) the operator next constructs an Rm scale from clear acetate. Mark an index point in the lower left corner and draw a straight line from the index point along the bottom of the scale. Place the Rm scale over the prediction graph aligning the bottom lines of the graph and scale. Location of the Rm graduations on the Rm scale are determined by using the predicted travel time formula discussed in paragraph C–3. (Example: To determine the 100-meter-a-minute mark, the formula will give the result that a distance of 500 meters will be traveled in 5 minutes. Draw a line from the index through the intersection of 500 meters and 5 minutes (line A–B, fig. C–9). Mark this as the 100-meter-a-minute line. All other rates may be calculated in the same manner. The Rm scale may be used with all prediction graphs of sensor strings which are drawn to the same scale.)

c. Figure C–10 illustrates how the Rm scale may appear when graduation marks are plotted in 10-meter-a-minute increments for Rm between 20 and 150 meters a minute.

d. To illustrate how the Rm scale is used with the prediction graph, figure C–11 depicts the following situation:

(1) An activation signal from sensor 11/21 (fig. C–7) is recorded at 0800 hours.

(2) An activation signal from sensor 12/21 (fig. C–7) occurs at 0803 hours. (Elapsed time between initial activations from the two sensors is 3 minutes.)

(3) Place the index of the Rm scale (fig. C–10) at the intersection of the line representing sensor 11/21 and the zero index line on the prediction graph (fig. C–8). Next, align the bottom line of the Rm scale with that of the prediction graph.

(4) Place a straightedge at the point where sensor 11/21 intersects zero time and the point where sensor 12/21 intersects the 3-minute line. (Straightedge is illustrated by line A–B, figure C–11.)

(5) By viewing figure C–11 and the straightedge illustrated by line A–B, note that the following predictions are readily apparent:

(*a*) Movement is occurring at a rate of approximately 90 meters a minute.

(*b*) A moving target should activate sensor 13/21 at 0807 hours or 7 minutes plus a fraction following the initial activation of sensor 11/21. (Note that the straightedge intersects the vertical line representing sensor 13/21 between the 7- and 8-minute lines. By visual inspection it can be seen that the intersection occurs at a point which is about one-fourth of the distance between the 7- and 8-

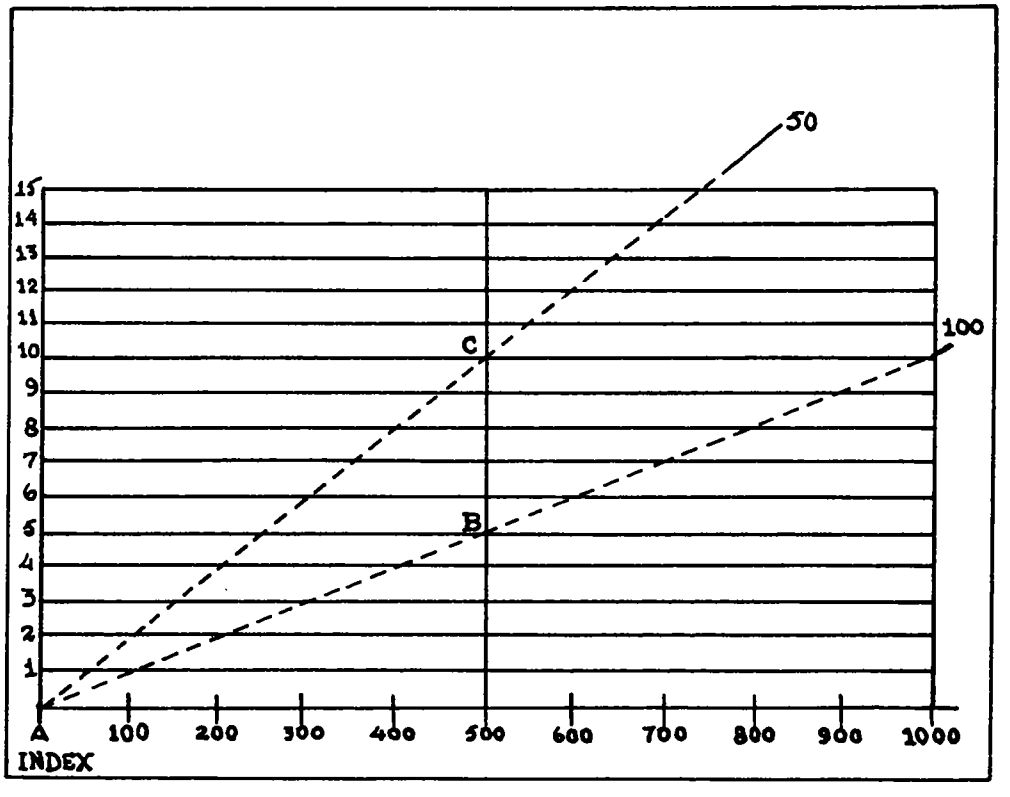

Figure C–9 (U). Meters a minute graduation marks on Rm scale (U).

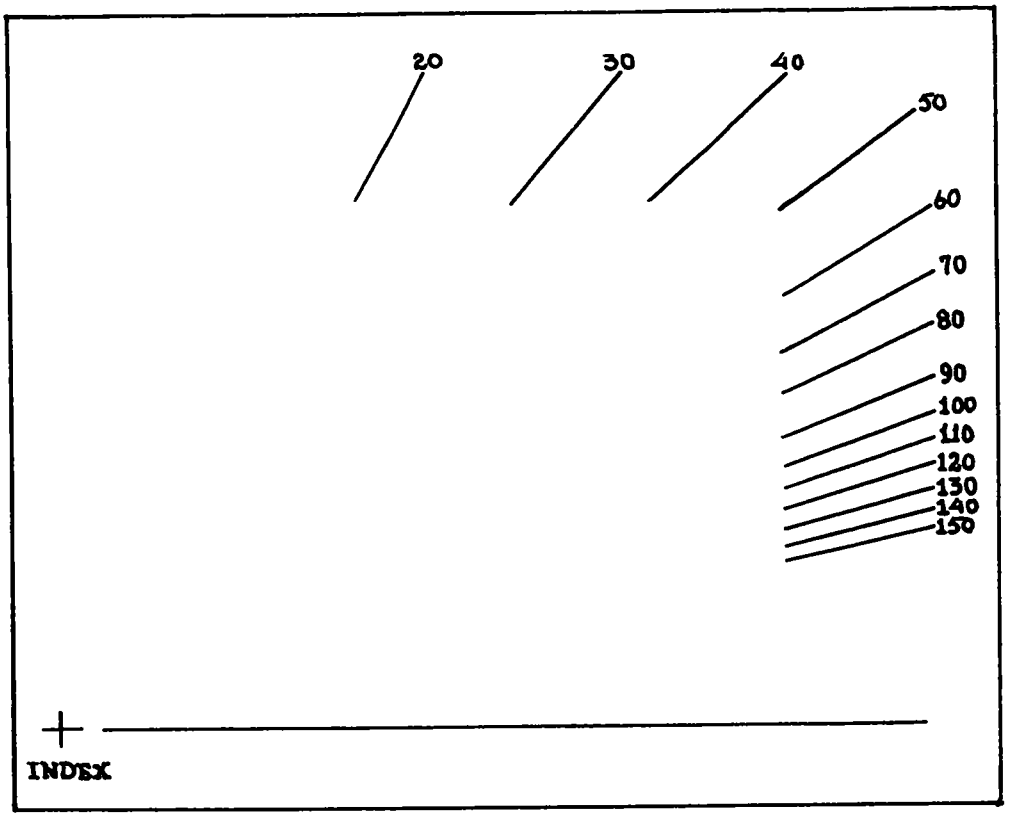

Figure C–10 (U). Example of Rm scale (U).

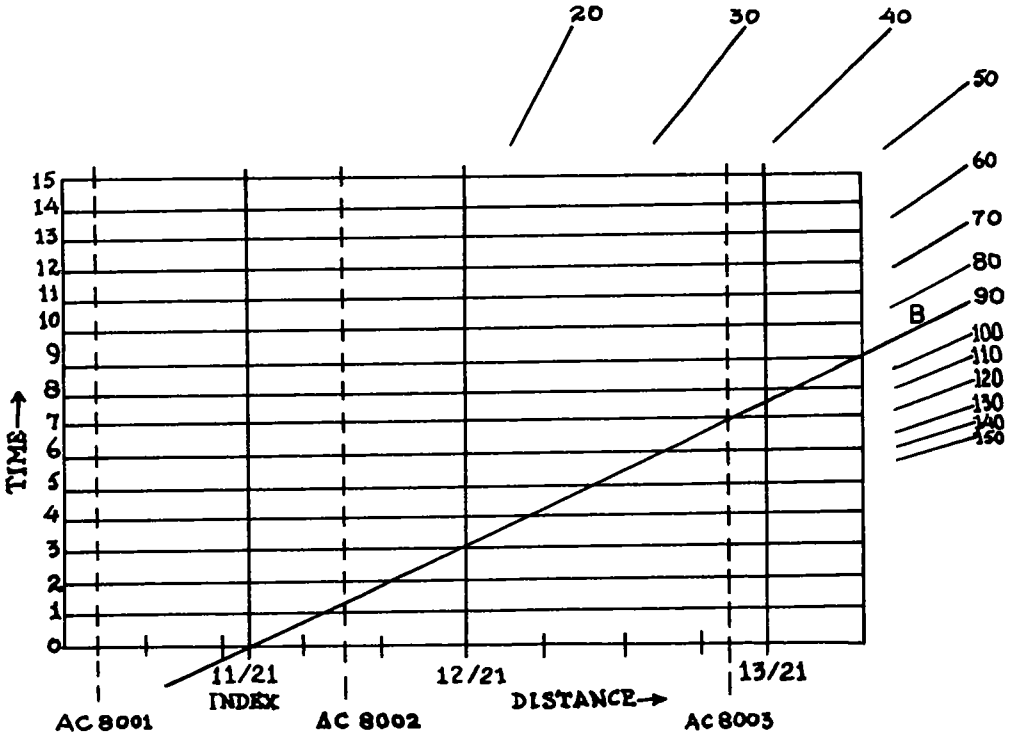

Figure C–11 (U). Rm scale superimposed over prediction graph (U).

minute lines; hence, the precise travel time is estimated at 7.25 minutes.)

(*c*) The above method will also apply for determining the arrival time at the artillery concentration points. (Example: Arrival at AC 8003 should occur 6.75 minutes following the initial activation of sensor 11/21 at 0800 hours.)

(6) The operator, noting that the Rm is predicted at 90 meters a minute, refers to the Rm conversion chart (fig. C–19) to aid in predicting the type of target. In this case the prediction is personnel moving in a nontactical situation.

C–6. (U) Other Considerations

a. In the foregoing examples the most optimum operating conditions were used to illustrate various operator techniques. There were no instances where the detection zone varied between like sensors although variations occur because of differences in the sensitivity of like sensors and the composition of the soil in the detection zones. Similarly, the examples display a uniform 10-second interval between sensor transmissions compared with random time intervals that normally occur between transmissions. In addition the preceding examples reflect no distracting spurious signals received during the times when moving targets were activating sensors in the sensor field. While it is entirely possible, occasions will rarely occur when both weather conditions and activities normal to the battlefield are dormant.

b. When activities in a sensor field are recorded manually, the operator is confronted with the questions, "Which of these radio frequency receptions represent actual detection of enemy movement and which are spurious in nature and false in the sense that they do not represent hostile activity in the sensor field?" To help sort out the answers to these questions in the mind of the operator, an effective technique is employed. Receipt of these signals is logged on the operator's log sheet at that portion of the minute in which the signal is received.

(1) The following illustrates such a situation. The operator receives an activation signal from Sensor No. 1. He notes the time the signal is received and records the signal on the log. Following a 9- to 12-second interval, a second activation signal is received. Following like intervals, the third and fourth signals are received from Sensor No. 1. However, immediately after the fourth activation signal is received from Sensor No. 1 and during that 9- to 12-second interval between sensor signals, an activation signal is received from Sensor No. 6. The operator mentally pacing the passage of time with the regularity of activation signals from Sensor No. 1 can anticipate receipt of the second activation signal from Sensor No. 6 immediately following the fifth activation signal received from Sensor No. 1. If the signal is received, it is logged. Whether it is a false signal remains unanswered. If the second activation signal from Sensor No. 6 is not received in the time interval between receipt of the fifth and sixth activation signal from Sensor No. 1, the operator automatically rejects the activity at Sensor No. 6 as false, unknown, or of no further interest. Simultaneously, the operator's attention reverts to the activity being detected by Sensor No. 1.

(2) A simple logging expedient records sensor activation signals at that portion of the minute in which each signal is received. Mentally the operator visualizes each sensor identification column on the log sheet as being divided into six vertical 10-second columns. Hence, to record receipt of an activation signal, the operator places the mark in that column which best represents the time within the minute that the activation signal was received. Using the series of activations discussed in the preceding paragraph, figures C–12 and C–13 show how the operator's log would appear when an operator employs this technique to log receipt of activation signals from two or more sensors concurrently.

(3) Although the manual logging technique shown in figures C–12 and C–13 enhances on the spot interpretations and those submitted at a subsequent time, an increased number of sensor activations will adversely affect, if not exceed, the ability of the operator to log these activations manually. Consequently, interpretations of manually prepared logs for sensor activations require that consideration be given to the human factors aspect and the degree of sensor activity recorded in the log.

C–7. (U) Event Recorder RO–376/USQ and BASS III XT Plotter

The event recorder and XT plotter eliminate time consuming manual tasks and overcome human frailties associated with logging sensor activation signals. The event recorder records activation signals from 1 to 30 sensors on a continuous basis for approximately 72 hours without stopping while XT plotter records up to 60 activation lines. Both devices are equipped with rolls of charting paper approximately 75′ long and record sensor activation signals while it unrolls from one spool to another at the rate of 12 inches an hour. As each sensor activation signal is received, it is recorded instantly as a horizontal dash mark in a preselected vertical column on the charting paper. To identify these horizontal dash marks with the sensor originating the signal, the event recorder and the XT plotter both contain a patch panel. This enables the operator to program the identity of sensors with any of the 30 or 60 numbered columns on the charting paper. Sensor

	SENSOR IDENTIFICATION				
TIME	# 1		#6		REMARKS
2100					
1					
2					
3					
4					

NOTE: First activation on Sensor No. 6 occurred between fourth and fifth activation of Sensor No. 1. If a sixth activation is received from Sensor No. 1 before a second activation from Sensor No. 6, the single activation signal received from Sensor No. 6 is of no consequence.

Figure C–12 (U). Operator technique for logging sensor activations in relation to actual time (U).

identities and their activation signals are recorded in preselected columns of the moving charting paper. The charting paper, as it unrolls, moves through the recording pens in a downward movement at a rate of 1 inch each 5 minutes. As a result of the downward movement, the operator starts interpretation of the data recorded on the charting paper at the bottom and works upward. If the event recorder had been used to record the sensor activity that was manually logged (fig. C–3), the recorded data on the charting paper would appear as shown in figure C–14.

C–8. (U) Automated Recording Versus Manual Logging

When the sensor activation signals recorded by the event recorder (fig. C–14) are compared with those that were manually logged (fig. C–3), the basic differences in the graphic presentation of identical data are apparent.

a. Instead of vertical dash marks, the event recorder employs horizontal dash marks. Although not shown, the XT plotter also employs horizontal dash marks.

b. The sequence of activity recorded by both recorder devices is reversed from that employed in manual logging operations.

c. Another basic difference not readily apparent when the charting paper is visually inspected results from the charting paper moving at a constant and uniform rate during the time sensor activation signals are being recorded. Sensor activation signals (horizontal dash marks) are not only recorded in the sequence as received, but in a manner that graphically and accurately portrays elapsed time.

C–9. (U) Similarity of Interpretation Techniques

a. The speed with which a moving target moves within the sensor field is not automatically provided by either recorder device as evident when viewing figure C–14. The same mathematical formula must be employed to obtain Rm data when detected movements are manually logged. As explained in

	SENSOR IDENTIFICATION				
TIME	#1		#6		REMARKS
2100					
1					
2					
3					
4					

NOTE: By recording the first activation signal received from Sensor No. 6 showing which 10-second interval in the minute that the activation occurred, the operator portrays the actual time that sensor activity started. Consequently, if activation signals continue to be received, data for any subsequent interpretations that may be contingent on actual time are available.

Figure C-13 (U). Operator technique for logging sensor activations in relation to actual time (U).

para C-3*a* and illustrated in figure C-20, the Rm is a result of dividing distance traveled by time. The known distance between Sensors No. 1 and No. 2 is divided by the time elapsed between the initial activation signal of Sensor No. 1 and the initial activation signal recorded for Sensor No. 2.

(1) The time that the initial activation signal from Sensor No. 2 was recorded on the charting paper must be estimated as shown in figure C-14. This is done by visual inspection. The time lapse between horizontal lines on the charting paper is three dashmarks short of a 2-minute horizontal line. The time interval between recording of the dashmarks conforms to the interval between sensor transmissions. In the original illustration the time interval between sensor transmissions was established at 10 seconds. Hence, the initial activation signal for Sensor No. 2 was recorded 30 seconds short of the moving charting paper reaching the second 2-minute marker; or, 3.5 minutes following the initial activation signal recorded for Sensor No. 1.

(2) The trail distance between Sensors No. 1 and No. 2 is 250m. The Rm between the two sensors is obtained mathematically as follows:

$$\text{Rm} = \frac{\text{distance}}{\text{time}} = \frac{250}{3.5} = 71+\text{meters a minute}$$

b. With Rm established the operator is able to predict location and/or arrival time of the moving target in relation to elapsed time. The technique is the same as explained in para C-3*b* for manually logged movement, i.e.:

$$\frac{\text{Distance to be traveled}}{\text{Rm}} = \text{minutes required to perform travel.}$$

c. While figure C-14 uniformly depicts movement occurring for 90 seconds (1.5 min) in the detection zone of each sensor, the intervals between sensor transmissions are rarely uniform in length. Further, soil texture creates irregularities in recorded sensor activities by increasing or decreasing the area of the sensor detection zones. Battlefield noises and various weather phenomenon also activate sensors and induce spurious signals that are recorded by both recorder devices. Considering the degradation of recorded data possible from these technicalities alone, the calculated length of a target moving

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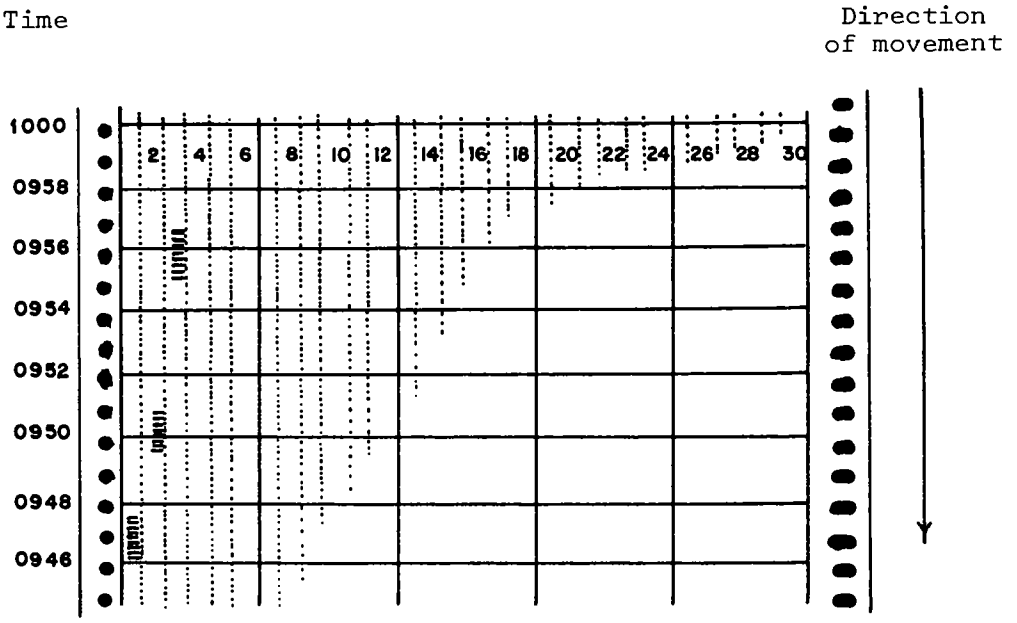


NOTE: Horizontal lines on charting paper represent distance the charting paper will move in 2 minutes. Rm is constant. Vertical lines, both solid and dotted, are equivalent to sensor identification columns on previously discussed operator's log. This illustrates how the identical sensor activation signals that are shown manually logged in figure C-3 would appear if logged by the event recorder.

Figure C-14 (U). Example of sensor activation signals automatically recorded with Event Recorder RO-376/USQ (U).

through a string of sensors is hardly more accurate than a mere guess.

C-10. (U) Interpretations Involving Vehicular Traffic

The recorded sensor activation signals (horizontal dashmarks) shown in figure C-15 are based on vehicular movement (para C-4) and shown as manually logged in figure C-6, i.e., four vehicles traveling at 300m a minute along the trail monitored by Sensors No. 1 through 5. Note that the pattern of the sensor activation signals recorded by the event recorder reflects a similarity to those manually logged.

a. Note that elapsed time between initial activations of sensors is easily estimated which in turn is used to arrive mathematically at the target's Rm.

b. To predict arrival time at a known location, the mathematical formula used is the same whether personnel move at 71m a minute or vehicles move at 300m a minute (divide the distance to be traveled by Rm and add to time that travel started).

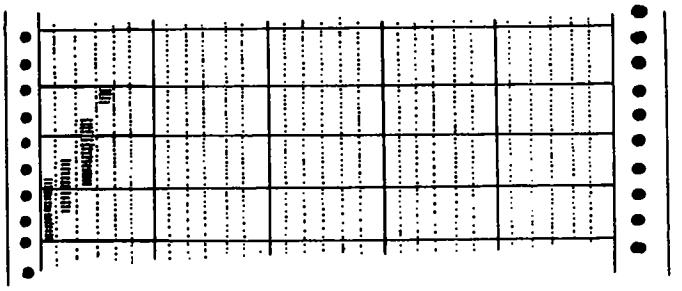
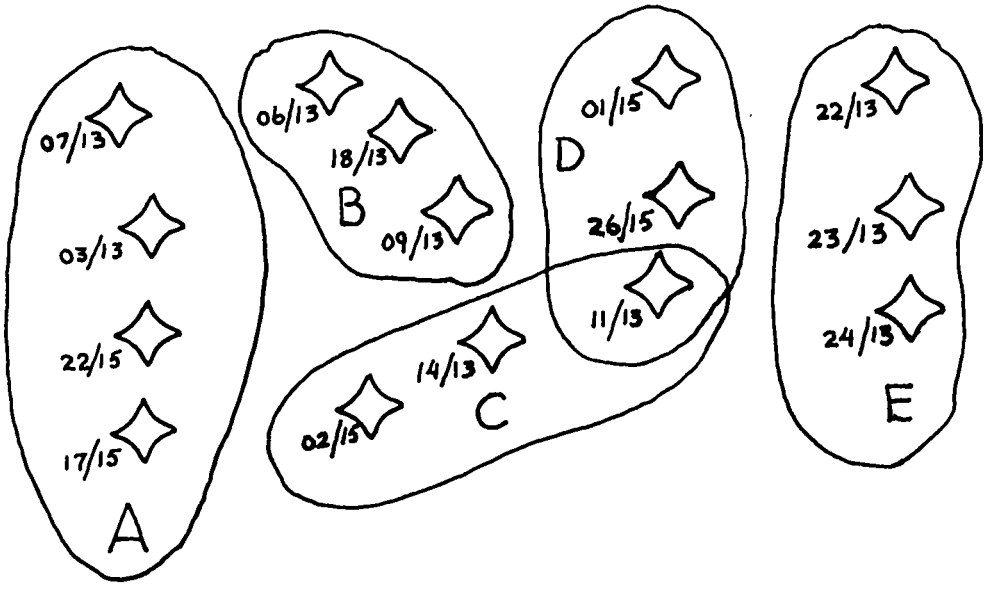


Figure C-15 (U). Example of sensor activation signals recorded with RO-376/USQ (U).



Legend: 03/15 — 03 - Sensor tone code; 15 - RF channel

NOTE: For clarity each string of sensors is circled and identified with a capital letter.

Figure C-16 (U). Sample sensor field (U).

C-11. (U) Programing the Event Recorder

a. The event recorder contains a patch panel that enables the operator:

(1) To designate which of the vertical numbered columns on the charting paper will be used to record activation signals and thus, identify the sensor transmitting the activation signal.

(2) By means of inserting one patch panel plug into another (in piggyback fashion), to designate more than one vertical column to record the activation signals from one specific sensor.

b. To show the capabilities of the patch panel and its usefulness in interpreting recorded sensor activation signals, refer to sample sensor field shown in figure C-16.

(1) To control the pattern and enhance interpretation processes of sensor activation signals recorded for a target moving through sensor string A, the operator should program the patch panel so the first sensor in string A will record in column 1, the second sensor in column 2, etc.

(2) When separate sensor strings are identifiable within the sensor field, and the required number of vertical recording columns does not exceed 30, the operator should program the patch panel so the recorded data from the various sensor strings will be separated from each other by one unused vertical column on the charting paper, that is, columns 1 through 4 should be used for sensor string A and columns 6 through 8 for sensor string B. Column 5 remains unused to separate and enhance interpretation of data recorded for each sensor string.

(3) When two sensor strings share a common sensor, the operator may desire to program the patch panel so that activation signals originating from the common sensor are recorded simultaneously in the appropriate column for each sensor string, i.e., sensor strings C and D share one common sensor. The operator programs separation of sensor string C from string B with column 9 and assigns columns 10, 11, and 12 to string C. Also after separating string D from string C with column 13, the operator assigns columns 14, 15, and 16 as follows:

Sensor 01/15 to column 14.
Sensor 26/15 to column 15.
*Sensor 11/13 to column 16.

*As previously explained, the single activation signal received from the common sensor (11/13) in the two strings can be directed to different columns of the charting paper and recorded simultaneously. In this example, activation signals from sensor 11/13 will be recorded in columns 12 and 16.

(4) If the operator is unable to patch a common sensor into two separate recording columns on the charting paper because of the total number of sensors in a field or for other reasons, the operator should program the patch panel so the common sensor's activation signals can be recorded and displayed as a part of the pattern for either string of sensors. The operator programs the patch panel so that activation signals from sensor strings C and D will be recorded and displayed in five columns adjacent to each other. The activation signals from the sensor common to both strings (11/13) should be programed for recording in the center column. Hence, the pattern created from recordings of activation signals originating in either sensor string would be displayed in adjacent columns on the charting paper.

C-12. (U) Patching Techniques

The patching techniques for the XT plotter are essentially the same as for the event recorder. The sensor identification codes are patched into columns on the charting paper from left to right and as they appear on a map looking west to east and north to south. Also, sensor strings are separated from unused columns.

C-13. (U) Recognition of Patterns

When the recorder devices are programed in the manner explained above, the recorded sensor activation signals will be displayed in various patterns. These patterns, which are sometimes called "signatures," are normally easy to detect by visual inspection of the recordings on the charting paper. To show how these patterns or signatures may appear to the operator/interpreter, figure C-17 depicts sensor activation signals that were recorded as a result of movement detected in and around the sensor field (see fig. C-16). Note that when non-hostile sensor activation signals are induced into the system and the reasons become known to the operator, he manually records the time on the charting paper, source of disturbance, and confirmation data. A well-trained operator can often distinguish between hostile and non-hostile sensor activations. Some techniques and considerations which aid the operator in making these distinctions are discussed in the paragraphs below.

a. As a rule, men usually move with regularity along defined routes. In contrast animals tend to wander along and vary their pace unless driven by someone or something. Hence, the pattern established by man can be expected to be more uniform than a pattern established by animals.

b. Natural phenomena such as thunder, lightning, wind, rain, and rapid temperature changes can cause sensor activations, from any or all sensors in a string or a field, but these events are usually sporadic and display no uniformity when recorded by the recorder devices.

c. Earth tremors caused by artillery fire (both the recoil action of the gun and the exploding ammunition at the target area) can cause the activation of several or all sensors in a string or field. Aircraft, both high-performance and rotary wing, can also cause the activation of a sensor that may be located in the general area. When this type of sensor activity is recorded, the pattern is normally characterized by the continuing activation of several sensors which commenced and then ceased simultaneously or within rapid succession.

C-14. (U) Confirming Sensors

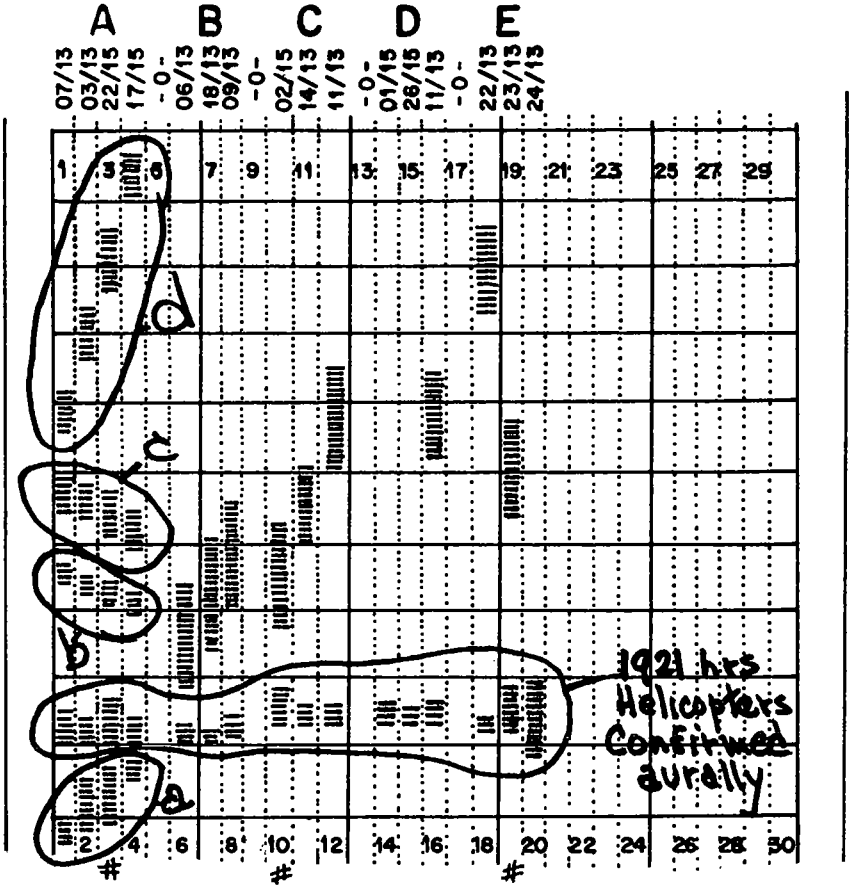
There are two sensors reliable for confirming intrusions. These are the acoustic (open-microphone type sensor) and the MAGID. When either of these sensors is satellited on the parent sensor and the parent sensor is set to operate in a mode that precludes the generation of an activation signal until preestablished criteria is satisfied in both sensors, the pattern recorded with each of the recorder devices differs greatly from those shown in figure C-17. As explained in paragraph C-4, it is possible for confirmation-type sensors to yield a count of moving objects in the moving target.

a. To accomplish this the interval between moving objects, as measured in elapsed time, must be sufficient to permit the recorder devices to register a separation between each of the activation signals. The illustrated recording of sensor activation signals in figure C-17 represents 10- to 12-second time intervals, i.e., 12 horizontal dashmarks between the 2-minute horizontal lines.

b. When walking personnel are maintaining a 5-meter interval while marching in single file at the relatively slow rate of 60m a minute, the space between individuals, measured in time, is 5 seconds. When recorded on the charting paper of either recorder device, the number of horizontal dashmarks would be double the number shown in figure C-17. It is conceivable that sensor activation signals recorded for walking personnel marching in double file at a rate of 90m a minute would be displayed as a series of overlapping horizontal dashmarks. Consequently, it may be impossible to make "a count" of personnel. The recorded pattern, however, should continue to be readily recognized and correctly interpreted as moving personnel.

C-15. (U) Graphically Displayed Spurious Signals

While technological advances are resulting in improved sensors, spurious radio frequency signals



Interpretation is made after Rm is established and an evaluation is made on size and length of target(s).

String A. Single vehicle movement:

a. N to S.
b. S to N.
c. Heavier vehicle, S to N.
d. N to S at slower speed.

String B. Several vehicles moving N to S in convoy.

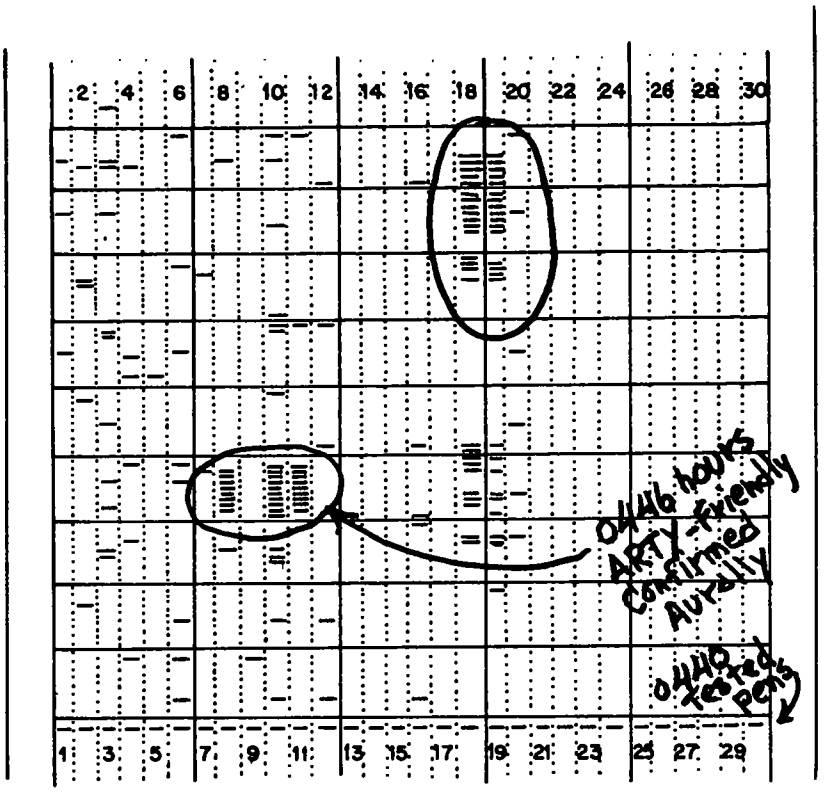
String C. Same interpretation as for string B.

String D. Sensor activation signals for sensors common to strings C and D.

String E. Walking personnel moving northward.

#Sensors appear to be more sensitive than others in the field.

Figure C-17 (U). Signature/pattern of sensor activation signals recorded with Event Recorder RO-376/USQ (U).



NOTE: To interpret the sensor activity encircled above, the operator must know the type of sensor, its sensitivity setting, and various sensor site information. Columns 18 and 19 are assigned to two seismic sensors which are emplaced near trees and in the vicinity of each other. Considering the irregularities in the pattern, the operator may logically assume that the sensor activations are nonhostile in nature.

Figure C-18 (U). Example of spurious sensor activation signals automatically recorded with Event Recorder RO-376/USQ (U).

continue to be received and recorded. Since these signals are spurious in nature, the intervals between signals are usually erratic enough to alert the operator to their presence. The irregularities in the time intervals become evident by the lack of uniformity in distance between the horizontal dashmarks when recorded by either of the recorder devices. Figure C-18 is a graphic display of how spurious sensor activation signals may appear when recorded by the event recorder.

Rate of movement—minutes to hours

Meters a minute	KM an hour	MPH an hour	Normal rate of movement
20	1	5/8	Carts pulled by oxen/buffaloes, self-propelled farm implements, etc.
30	1½	15/16	
40	2	1¼	
50	2½	1 9/16	
60	3	1⅞	Personnel—night movement on footpath.
70	3½	2 3/16	Personnel—stealthy movement.
80	4	2½	Personnel—movement to contact.
90	4½	2 13/16	Personnel—forced march.
100	5	3½	Personnel—forced march.
110	5½	3 7/16	Personnel—moving quickly.
120	6	3¾	Bicycle, rickshaw, pettycab (3-wheel), motor vehicles and personnel at double time, etc.
130	6½	4 1/16	
140	7	4⅜	
150	7½	4 11/16	
*160	8	5	

*Any movement greater than 160 meters a minute is assumed to be motor driven vehicles.

Figure C–19 (U). Conversion chart (U).

1. (U) Abbreviations used in formulas:

Rm—rate of movement in meters a minute
Mdz—minutes and fractions thereof in detection zone
Tddz—trail distance in detection zone (meters)

2. (U) Rate of movement:

$$Rm = \frac{\text{distance in meters}}{\text{time taken to travel the above distance}}$$

3. (U) Predicted travel time/arrival time:

$$\frac{\text{Distance to be traveled}}{Rm} = \text{predicted travel time}$$

Add predicted travel time to time travel started=predicted arrival time.

4. (U) Length of moving target:

Rm×Mdz−Tddz=length of moving target. Requires four steps:

Step 1. Attain Rm via formula above, refer to annex C–1 and make decision on whether movement is by foot or vehicle.

Step 2. Refer to operator's log or event recorder tape and estimate Mdz for one sensor.

Step 3. Based on step 1 decision, estimate Tddz. (Estimated length of the passageway that occurs within the detection zone of the sensor and which was used by the moving target.)

Step 4. Insert data and mathematically solve above formula.

Figure C–20. (U). Mathematical formulas (U).

APPENDIX D (C)

SENSOR CHARACTERISTICS AND EMPLOYMENT TECHNIQUES (U)

Sensor	Type	Operating Life (days)	Emplacement Method	Recoverable	Weight (lbs)
ACOUSID	Acoustic/seismic	90	Air	No	37.5
ADSID/S	Seismic	7–120	Air	No	14
ARFBUOY/NBB	Disturbance	90	Hand	Yes	12
DSID	Seismic	7 or 65	Hand	No	4.5
EMID*	Electromagnetic	45	Hand	Yes	14
MARDS	Seismic	7–15	Artillery	No	13
MICROSID	Seismic	30 to 45	Hand	Yes	4.5
MINISID	Seismic	60	Hand	Yes	9
AAU*	Acoustic	30 to 60	w/MINISID	Yes	7
MAGID-T4	Magnetic	60	w/MINISID	Yes	7

*Equipped w/diurnal switch for optional night-only operation.

APPENDIX E (U)

ACRONYMS, GLOSSARY, AND DEFINITION OF TERMS (U)

AAU	Audio add-on unit.
ACOUSID	Acoustic and seismic intrusion detector.
ADSID/N	Air-delivered seismic intrusion detector (normal).
ADSID/S	Air-delivered seismic intrusion detector (short).
ARFBUOY	Automatic radio frequency buoy.
BASS	Battle area surveillance system.
BRC	BASS relay central (subsystem).
CU	Control unit.
CT	Command transmitter.
DAFT	Detachable afterbody.
DSID	Disposable siesmic intrusion detector.
EMID	Electromagnetic intrusion detector.
ETA	Estimated time of arrival.
EXRAY	Expendable relay.
FDC	Fire direction center.
FU	Firing unit.
LORAN	Long-range navigation system.
LORES	LORAN retransmission system.
MAGID	Magnetic intrusion detector.
MCRU	Multichannel receiver unit.
MICROSID	Microminiaturized seismic intrusion detector.
MINISID	Miniaturized seismic intrusion detector.
MURP	Multichannel universal relay package.
NBB	Noiseless button bomblet.
PCT	Portable command transmitter.
Portatale	Portable radio readout device.
REMBASS	Remotely monitored battle area surveillance system.
RF	Radio frequency.
RFD	Remote firing device.
Rm	Rate of movement.
SARS	Sensor analog relay system.
SDU	Sensor display unit.
TDV	Terminal delivery vehicle (sensor case for MARDS).
UGS	Unattended ground sensor.
Acoustic sensors	Devices which are sensitive to vibrations in fluid media (atmosphere or water) in the frequency range below 20 KHz. Acoustic sensors aid in target discrimination and confirmation. The effectiveness of acoustic sensing is limited by ambient noise as are many sensing methods. This type of sensor is effective when used as an extension of human hearing.

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Combination sensing techniques.	Combination of two or more sensing capabilities in a single device.
Commandable sensor	An unattended sensor which will accept RF commands directing its activity.
Diurnal switch	A daylight sensing device which is used to deactivate UGS's during daylight hours.
Disturbance sensors	Sensors which transmit an RF signal each time they are disturbed (physically moved).
Electromagnetic sensors	Sensors which operate by detecting changes of reflected antenna impedance.
Event recorder	Common name for 30-pen Signal Data Recorder, RO-376/USQ.
FM/FM relay	A system for relaying sensor response data.
Magnetic sensors	Intrusion detectors using magnetometers of search coils which detect environmental change by measuring the rate of change of magnetic flux caused by the motion of ferrous material within their detection range.
Mdz	Minutes and fractions thereof in detection zone.
Phase III sensors	Phase III sensors essentially duplicate the Phase I and II families of sensors in capabilities; however, they have an increased number of addresses available and use of different message format.
Seismic sensors	Sensors that use one or more geophones which are sensitive to very low seismic vibrations in the ground.
Sensor field	A sensor field consists of one or more detection devices emplaced in areas of operation and interest.
Tddz	Trail distance in detection zone.

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